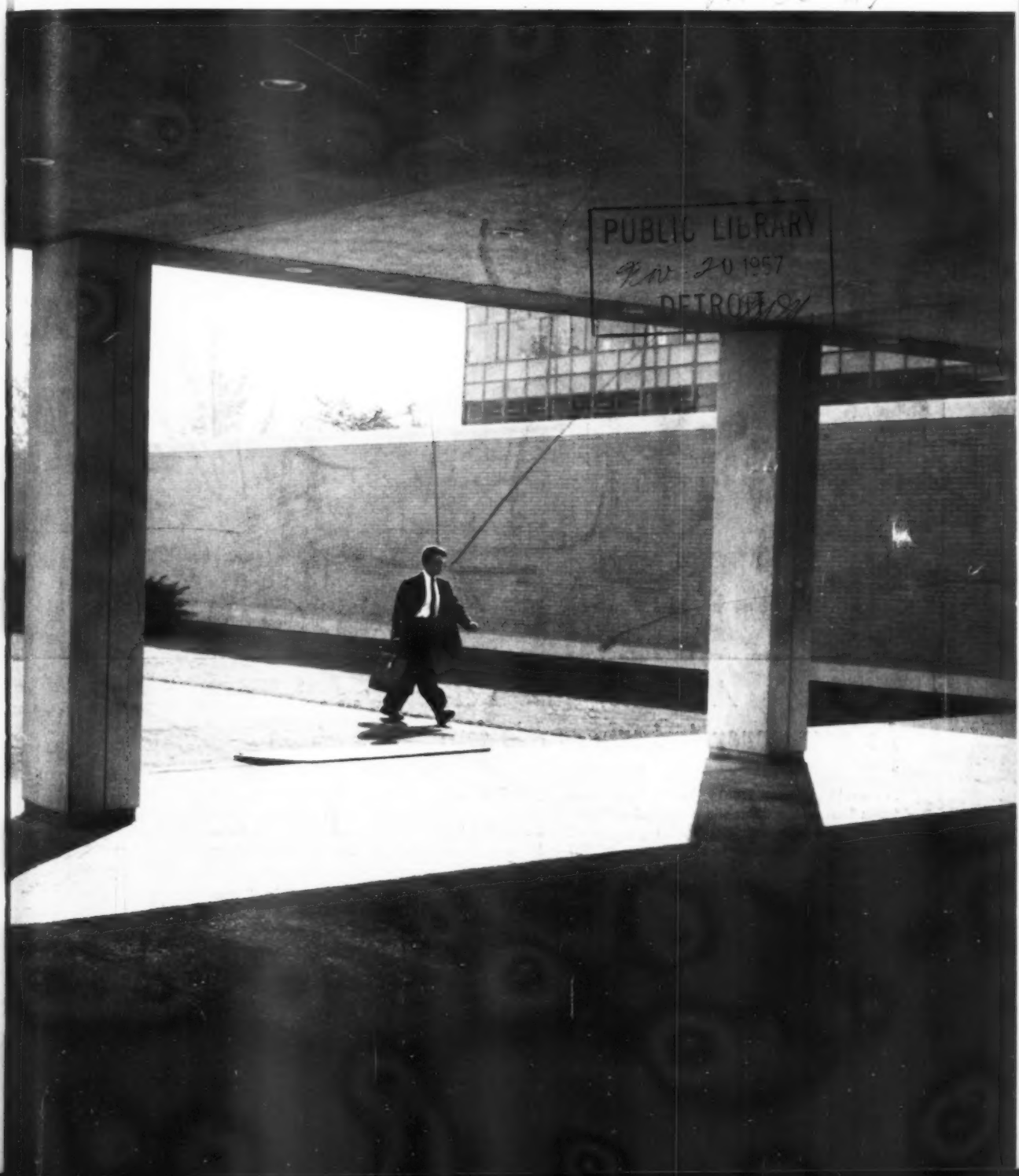
TECHNOLOGY DEPT.

# TECHNOLOGY REVIEW

November 1957



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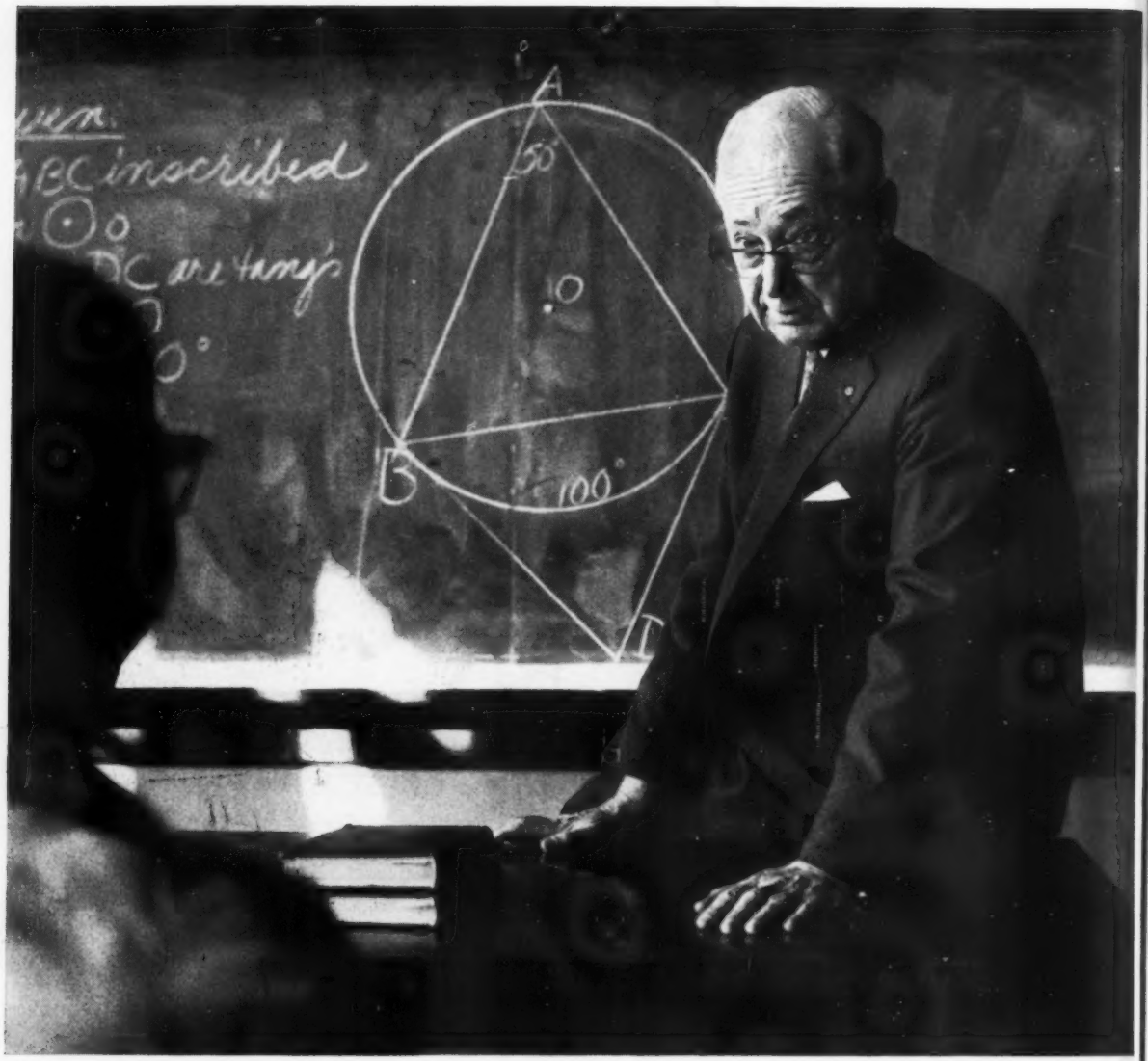
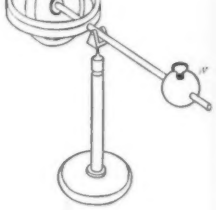



## *A Teacher affects eternity... he can never tell where his influence stops*

. . . wrote historian Henry Brooks Adams—a truth that today demands universal recognition. America is losing to industry many of those best able to inspire and mold youthful minds—the dedicated teachers of high school subjects prerequisite to engineering training.

The value of a teacher's influence in a boy's selection of a career cannot be over-estimated, yet all too often the rewards of teaching are more spiritual than material. Compensation fitting the importance of their work can help keep teachers in their classrooms, where they prefer to be.

*America gains every time teaching is chosen as a career. It also gains whenever a teacher finds it possible to remain in the profession.*



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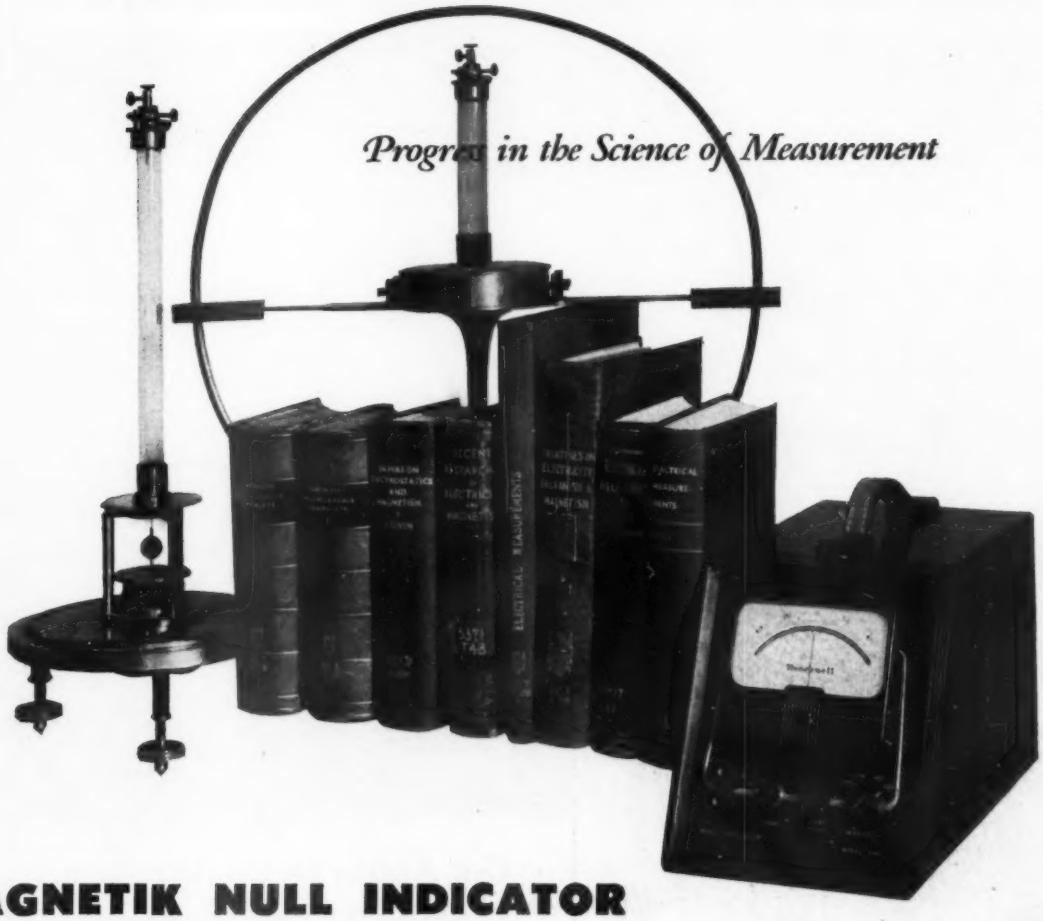


# MAGNETIK NULL INDICATOR

## *Today's Version of the D-C Galvanometer*

The D-C Galvanometer was essential to the historic experiments in electricity conducted by men like Galvani, Ampere and Lord Kelvin. However, the dense stray fields of today's electrical world combined with the need for greater speed and accuracy in the laboratory and on the production line place a heavier burden on the present day galvanometer. The Honeywell Magnetik Null Indicators are today's most practical version of the D-C Galvanometer. Not only do they combine magnetic and electronic elements which make them insensitive to stray pickup; but they have 3 discreet ranges, a linear scale for deflection measurements, fast response and the ability to withstand overloads as high as 100,000 times full scale deflection. Model 2HG-1P (shown above) is available as a portable unit. Model 2HG-1R (not shown) is designed for rack mounting. *Write for Bulletin NI-1,* Minneapolis-Honeywell, Boston Division, Dept. 1, 1400 Soldiers Field Road, Boston 35, Mass.

**PERFORMANCE CHARACTERISTICS**

**ISOLATED INPUT:** Input terminals are isolated from chassis and circuit ground.

**HIGH SENSITIVITY:** 2 Microvolts per division, 0.003 Microamperes per division.

**HIGH CONVERTER FREQUENCY:** 2500 cps carrier, insensitive to 60 or 120 cps pickup.

**LOW NOISE LEVEL:** Less than 2 Microvolts equivalent input.

**EXCELLENT STABILITY:** Zero drift less than 1 division per hour.

**INDEPENDENT OF LINE VOLTAGE:** No observable drift or change in sensitivity for line variations from 105 to 125 volts.

**PROPORTIONAL DEFLECTIONS:** Linearity over full scale range is 5%.

**POLARITY SENSITIVE:** Zero-center mirror-scale meter for polarity sensing measurements.

**QUICK READING:** Time constant of less than 1 second.

**RUGGED:** Not damaged by over-range of 45 volts d-c.

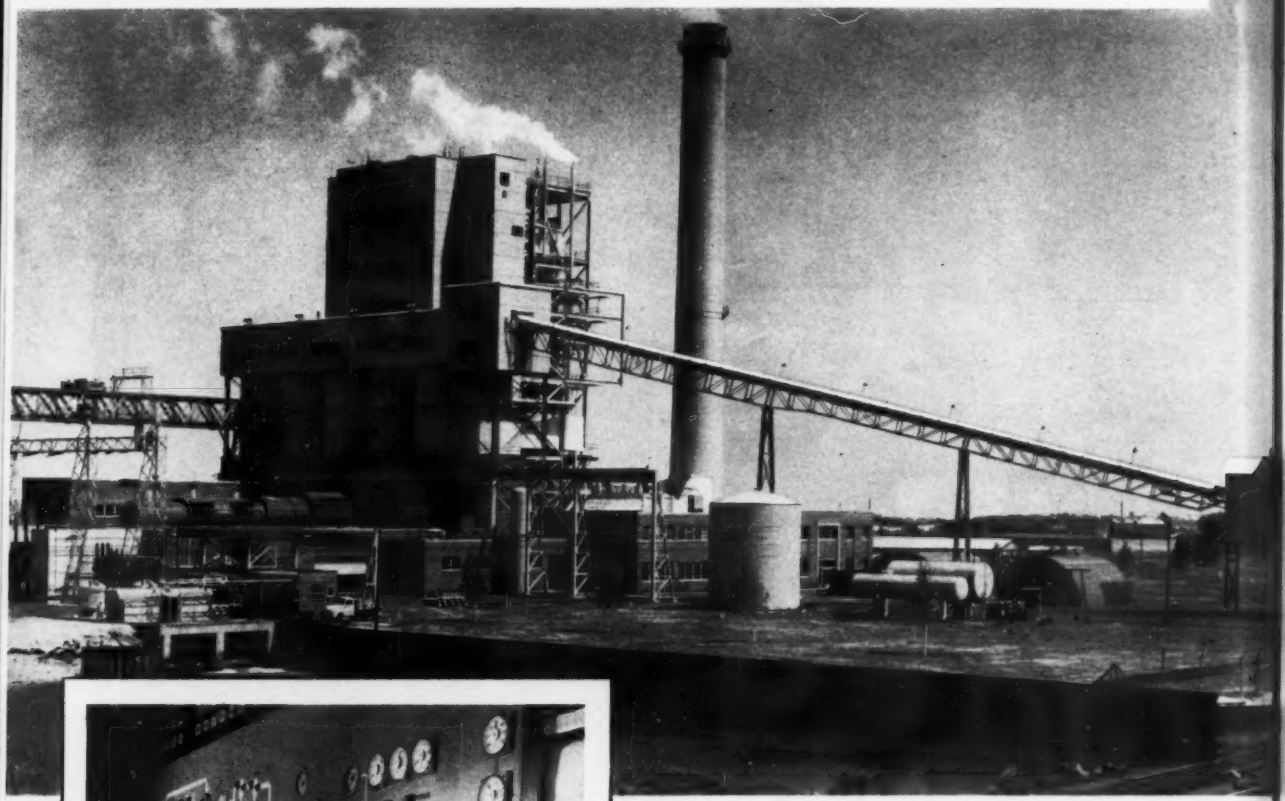
**LOW MAINTENANCE:** Only one vacuum tube. No moving parts except meter.

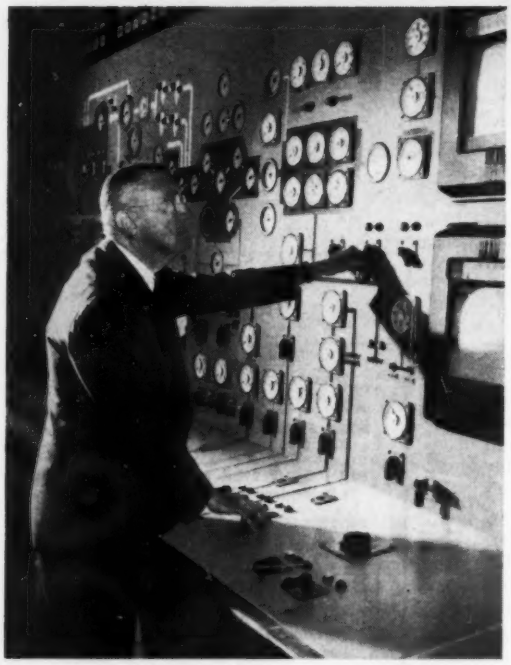
MINNEAPOLIS **Honeywell** H HONEYWELL

BOSTON DIVISION

THE TECHNOLOGY REVIEW, November, 1957, Vol. LX, No. 1. Published monthly from November to July inclusive at Emmett Street, Bristol, Conn. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription, $4.00: Canadian and Foreign subscription, $4.50. Entered as second-class matter December 23, 1949, at the Post Office, at Bristol, Conn., under the Act of March 3, 1879.

*Electrifying news about America's fastest growing area...*





Edward F. Barrett, LILCO's Chairman of the Board—for whom the new station was named—throws the switch coupling station to the company's transmission network.

## C-E Again Helps Satisfy A Skyrocketing Demand For Power

The postwar years have seen the Long Island Lighting Company challenged to meet the electrical demands of the fastest growing area of its size in the United States. The new Edward F. Barrett Station, shown above, represents this progressive utility's recently dedicated addition to the system's generating capacity. Ten years ago, Barrett's single generating unit could have provided power for *all* of LILCO's customers. Today, however, it accounts for only one-fifth of the capacity of the Company's five generating stations. And, with an eye to the future, provisions have been made to allow expansion of the ultra-modern Barrett plant to *six times* its present capacity.

Combustion Engineering has played a major part in LILCO's phenomenal growth. In the past ten years, the utility has purchased eight large C-E boilers—seven of which are now in service, When the eighth unit goes into service next year, these boilers together will supply steam to generate nearly 900,000 kilowatts.

This record of *continued* acceptance by one of the country's outstanding utilities is further evidence not only of Combustion's leadership in steam generation but also of its ability to serve you—whether you need boilers for a giant power station or a small industrial plant.

# COMBUSTION ENGINEERING

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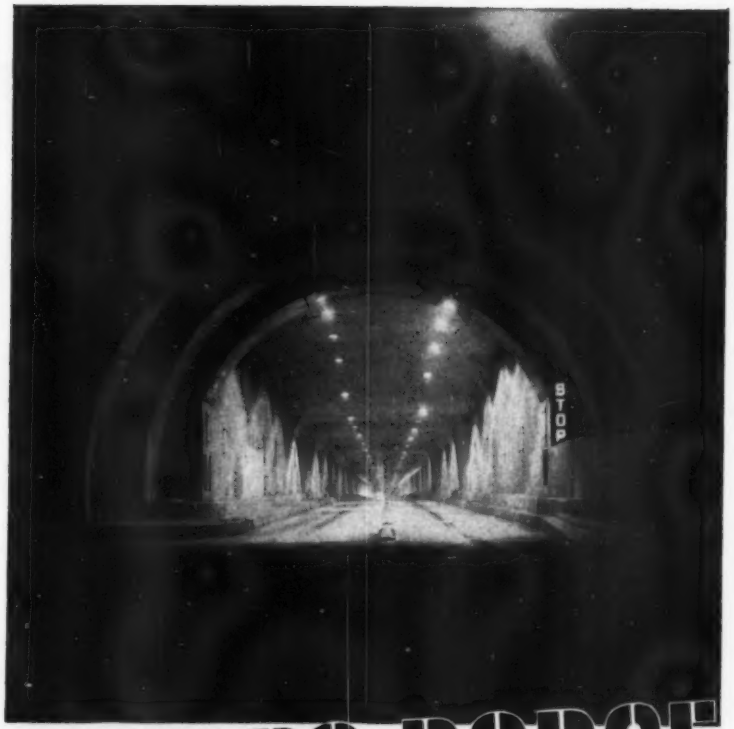
Pennsylvania's Turnpike... Model for Modern Motoring




# WIRE BY PHELPS DODGE

When the Pennsylvania Turnpike opened in 1940, it was the first modern highway of its kind in the East. Since then, it has earned a reputation as a model super-highway whose design combines a free flow of traffic with a low accident rate.

One of the requirements for the Turnpike tunnels, interchanges, approaches and portal buildings was an electrical system of the highest quality. That's why Phelps Dodge building wire and rubber insulated, neoprene-jacketed cable was installed. For 17 years, this wire and cable has been giving the Turnpike dependable, trouble-free service.

On every wiring job where top-quality performance, expert workmanship and experienced "know-how" are called for, *it pays to rely on Phelps Dodge and your Phelps Dodge distributor!*

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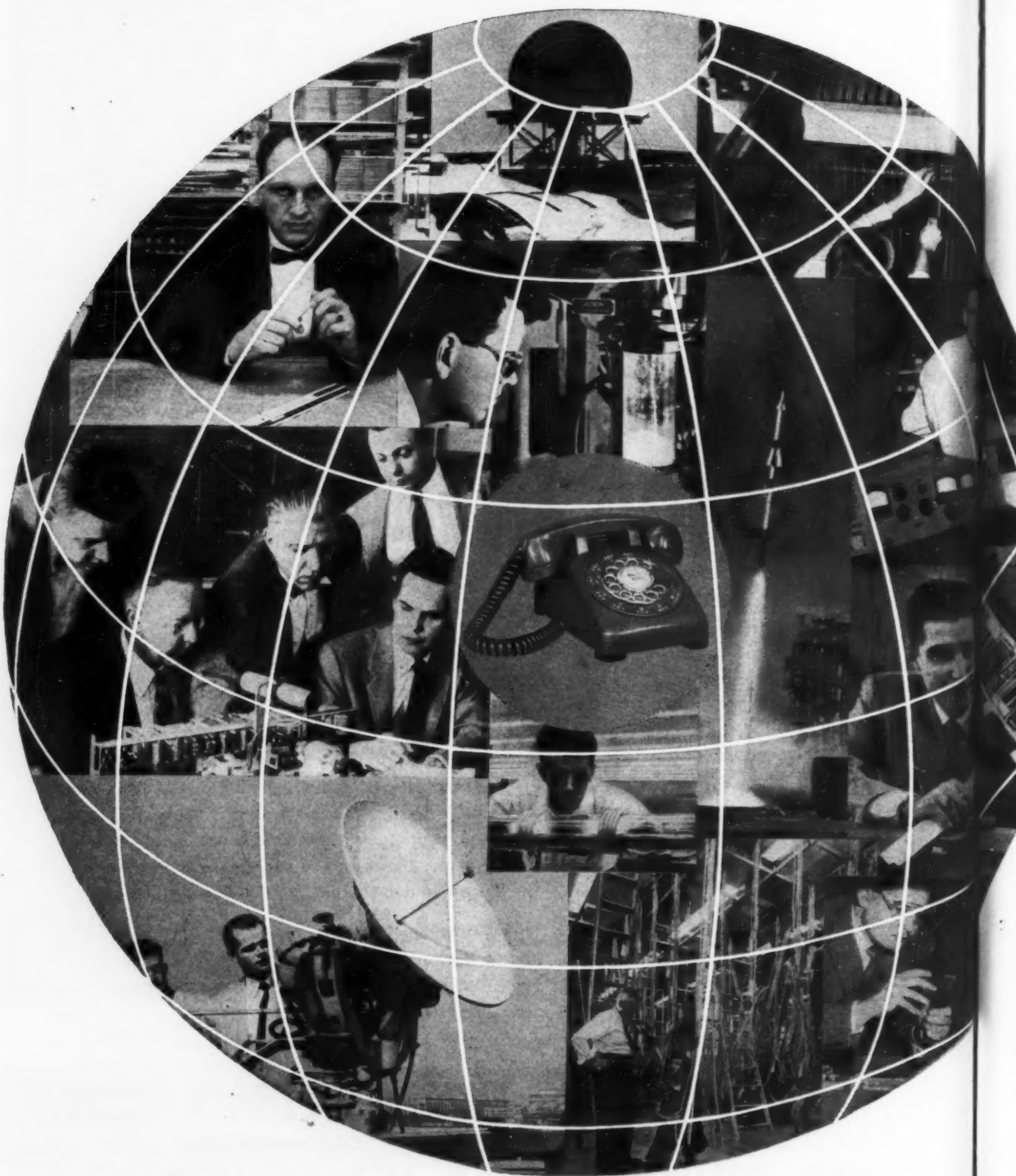
# There's an engineer's



● Western Electric has major manufacturing plants located at Chicago and Decatur, Ill., Kearny, N. J., Baltimore, Md., Indianapolis, Ind., Allentown, Pa., Winston-Salem, N. C., Buffalo, N. Y., North Andover, Mass. Distribution Centers in 30 cities. Installation headquarters in 16 cities. General headquarters: 195 Broadway, New York, N. Y. Also Teletype Corporation, Chicago 14, Illinois.

# r's world at Western Electric

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EVIEW

As THE world's largest manufacturer of communications equipment our continued progress depends greatly on our engineers. They have a key role in the production of some 50,000 types of apparatus and component parts that Western Electric makes in a given year.

● To our engineers falls the monumental task of developing manufacturing operations and of planning the installation of telephone central office equipment across the nation. They devise the new machines, tools and methods needed to do our job. They also shoulder the major responsibilities in carrying out the defense contracts the government has asked us to take over — major projects like the Nike guided missile system and SAGE, the continental defense system.

● In the course of their technical work, engineers participate in such broad managerial functions as production, merchandising, installation, and many others. What's more, we have a record of promotions from within. It's not surprising, therefore, that fifty-five percent of the college graduates in our upper levels of management have engineering degrees.

● Naturally we do everything possible to encourage and speed the professional development of our engineers. Just recently, for example, we inaugurated a full-time off-the-job Graduate Engineering Training Program at special training centers, a program with few parallels in American industry.

● The new engineer moves into the first phase of this program, **Introduction to Western Electric Engineering,** four to six months after he joins us and devotes nine weeks of study to such technical subjects as communications systems, military electronic systems, product design principles. He takes part in the second phase, **General Development,** after the first year on the job. In this phase he devotes nine weeks to courses in human relations, semantics, engineering statistics, electronics, measurements and instrumentation, systems circuit analysis. The third phase, **Advanced Development** (4 weeks per year), is available to selected engineers and is geared to the individual to help develop his creative engineering abilities; goes deeply into such subjects as magnetics, computer applications, electronic switching, radar fundamentals, feedback control systems and technical paper writing.

● Besides this company-wide program, a number of our divisions offer individual engineering courses in their own specialties. We also sponsor a Tuition Refund Plan for out-of-hours study at nearby colleges. Open to all employees, this plan helps our engineers study for advanced degrees at Company expense.

● Truly there's an engineer's world here at Western Electric . . . one in which engineers in every field of specialization can expect to grow.

## OPPORTUNITIES FOR ENGINEERING GRADUATES

*(Supervisory and administrative opportunities exist in each field)*

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**Planning telephone central offices:**
Equipment requirements — E.E.; Power and cable requirements—E.E.

**Development and design:**
New machines and tools—M.E., E.E.; Material handling methods—M.E., I.E.; New equipment and processes—M.E., E.E.; Repair shop methods—M.E.; Testing facilities—E.E.; Testing methods—E.E.; Job evaluation studies—I.E.; Wage incentive studies—I.E.; Production control studies—I.E.; Improved chemical processes—Chem. E., Met. E., Phy. Sc.; New application for metals and alloys—Chem. E., Met. E., Phy. Sc.; Raw material test procedures—Chem. E., Met. E., Phy. Sc.; Service to military on electronic devices—E.E.

---

**For further information write: Engineering Personnel, Room 1034, 195 Broadway, New York 7, N. Y.**

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# FIRST SNARK SQUADRON ACTIVATED

## Snark Guided Missile Becomes Operational

**HAWTHORNE, CALIF.**—The United States Air Force has announced that its first Northrop Snark SM-62 intercontinental guided missile squadron will be activated late this year. The Snark will be the first such missile to come into operational use.

The squadron, to be assigned to the Strategic Air Command, will be equipped with the high-altitude, jet-propelled Snark missile capable of delivering a nuclear warhead.

The exact site for the new missile unit was not disclosed but SAC officials emphasized that missile units will be so positioned as to reduce problems of noise and to insure that missiles, if ever fired, will not pass over heavily populated regions.

No missiles will be launched from operational sites except in case of attack. For training purposes missile crews will practice actual firing at an established range such as Patrick Air Force Base, Florida.

The Snark missile squadron will be manned by some 500 officers and men. Personnel are now undergoing training in the operation and maintenance of the Snark at Northrop.

The engineering division at Northrop continues in its development work on the Snark while they are in production. Other advanced projects in manned and pilotless flight are also in various stages of development at Northrop's new multi-million dollar engineering and science center in Hawthorne... all of them vital to the defense of America and other countries of the free world.

5-A-141


# missile engineers

As space becomes the missile engineer's province the demand for highly competent talent is ever present. Each development uncovers other areas for advanced study.

Beneath the imposing skyline at Northrop, engineers in the new multi-million dollar Engineering and Science Center are tackling today the problems of tomorrow's flights into space.

Scientists and engineers at Northrop have many accomplishments to their credit, including the USAF-Northrop SM-62 Snark intercontinental guided missile, first such weapon system to become operational with the Strategic Air Command. Research continues on preliminary and advanced projects involving missile guidance and controls, propulsion, flight test engineering, and similar areas of prime importance.

Northrop's 18 years of experience in pilotless flight is seldom matched by other manufacturers in the aircraft or missile fields. This reputation is a principal reason why experienced engineers and scientists have joined the Northrop Engineering Division. As work progresses on the USAF Snark and other vital missile projects career opportunities become available for qualified missile engineers.

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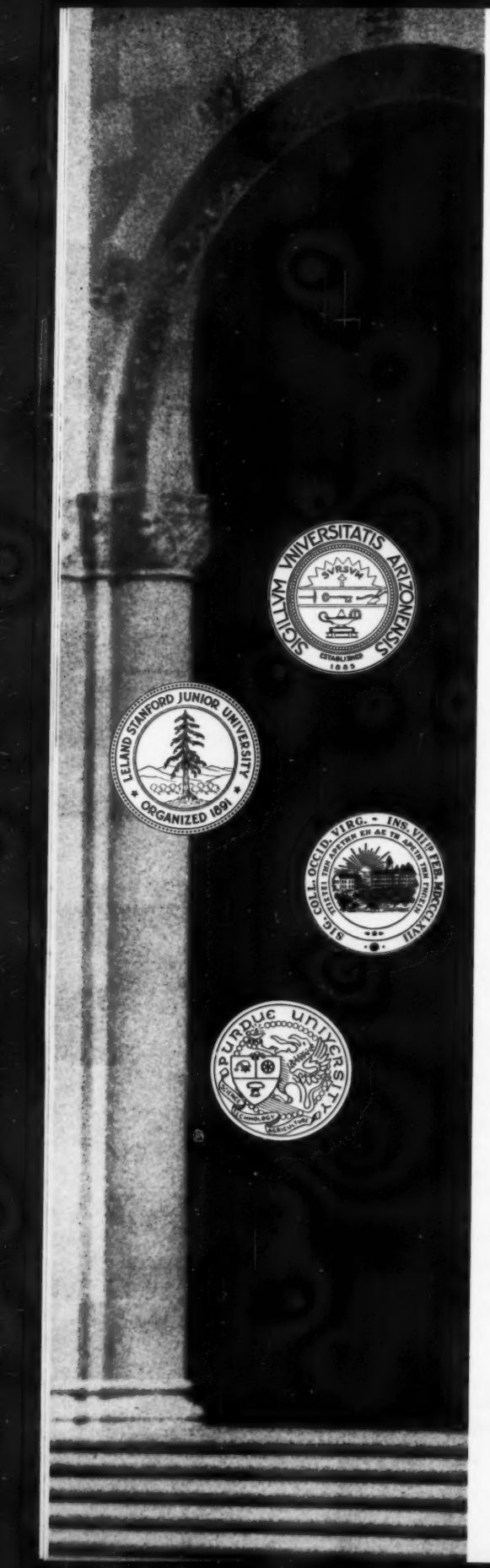

## howard hughes fellowships

Ten awards are open to candidates interested in studies leading to a Doctor of Philosophy or Doctor of Engineering degree or in conducting post-doctoral research.

Each Fellowship provides a cash award of not less than $2000 . . . a minimum salary of $2500 for summer or part-time work . . . up to $1500 for tuition, books, and research expenses . . . and moving and transportation costs. Eligibility is based on the completion of one year of graduate work in physics or engineering, and qualification for graduate standing at California Institute of Technology, University of California (Berkeley), or Stanford University. Application closing date: January 15, 1958.

## master of science fellowships

One hundred awards are open to participants who will complete courses leading to the Master of Science degree within 2 academic years. Tuition, admission fee, and books will be provided. During the summer they will have the opportunity to work with experienced Hughes scientists and engineers, while receiving salaries based upon their ability and technical experience.

Applicant must receive his B.S. degree during the coming year in Aeronautical Engineering, Electrical Engineering, Mechanical Engineering, or Physics. Participant may request his graduate school from the following six institutions: University of Southern California, UCLA, Stanford University, University of Arizona, Purdue University, or West Virginia University.

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*Answering these questions may help you decide whether you should consider a change.*

1. Is your financial advancement in line with your years of experience? YES ☐ NO ☐

2. Do you have sufficient freedom in your work? Can you move on your own — make independent decisions? YES ☐ NO ☐

3. Does your job stimulate you to make full use of your education and abilities? Is it providing the training necessary for future growth? YES ☐ NO ☐

4. Are you receiving adequate security? Is your future protected by group insurance and retirement benefits? YES ☐ NO ☐

5. Is there social and professional recognition attached to your present field? YES ☐ NO ☐

6. Do you have the satisfying knowledge that your work is important — that it contributes to the welfare of others? YES ☐ NO ☐

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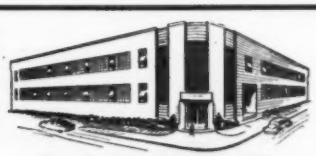
# THE TABULAR VIEW

**Scientist Compton.** — The tribute of one scientist to another is given (page 27) to the late Karl Taylor Compton by GEORGE R. HARRISON, Dean of the School of Science. Dean Harrison's address was delivered at the dedication of the new Karl Taylor Compton Laboratories on June 10, as part of this year's Alumni Day program, but was held for this issue which contains a description of the new laboratories of physical science. Born in San Diego on Bastille Day during the Spanish-American War, Dean Harrison received the A.B., A.M., and Ph.D. degrees in 1919, 1920, and 1922, respectively, from Stanford University. Even before both men came to Technology in 1930, Dr. Harrison was closely associated with former President Compton. As reported in Dean Harrison's article, both worked together in planning the Eastman Laboratories at M.I.T. and on many scientific and administrative problems thereafter. Dean Harrison is outstandingly suited to the task of paying tribute to Dr. Compton, not only because of the many close ties between the two men who worked together for more than a quarter of a century, but also because Dean Harrison is collecting material and writing a biography of Karl Taylor Compton.

**New Facilities.** — This fall, superb new facilities for teaching and research in the physical sciences are being used for the first time at the Institute. These include the new Karl Taylor Compton Laboratories for studies in the physical sciences and the nuclear reactor now nearing completion. The Compton Laboratories building houses the headquarters of the Research Laboratory of Electronics, the Laboratory for Nuclear Science, and a brand new Computation Center. The description of these new facilities (page 29) has been prepared by The Review's Editor, with the assistance of the M.I.T. Photographic Service, and members of the office of the Director of Physical Plant, and of the Institute's Faculty.

**Presidential Report.** — Always stimulating and instructive, this year's annual report of PRESIDENT JAMES R. KILLIAN, JR., '26, to the members of the M.I.T. Corpora-

*(Concluded on page 12)*



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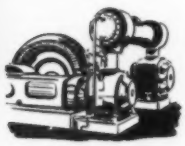
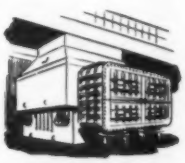


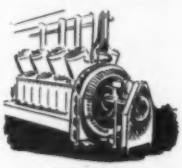
**Compressors and Blowers**

**Rock Drills**

**Air & Electric Tools**



**Steam Condensers**



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## THE TABULAR VIEW

*(Concluded from page 10)*

tion (page 39), provides a keen analysis of many problems now requiring solution in higher education in the United States. It compares the year's progress at M.I.T. with recent recommendations of President Eisenhower's Committee on Education Beyond the High School, and points the direction in which future M.I.T. effort might best be headed. In Dr. Killian's view, a first-class faculty is the greatest need of today's colleges and universities. But the teaching profession must safeguard its future as well. One of the most effective ways of achieving this end is by making faculty salaries comparable with those paid in industry. Another is to pay particular attention to the training of today's students, and to encourage more of the abler ones to become tomorrow's teachers and professors. Dr. Killian has had a brilliant career and, especially since becoming President of M.I.T., has been actively engaged as Presidential Adviser on numerous occasions. He has served as member or chairman of important governmental committees to recommend educational and scientific policies at the national level, and is a respected and much sought-after, public-spirited educator and administrator.

**Alumni Conference.** — Another Technology Review report, this time prepared by WALTER L. MILNE, Assistant to the Director of Public Relations, reports the Second Alumni Officers' Conference held on September 6 and 7 at the Institute. Mr. Milne received the A.B. and A.M. degrees from Brown University in 1943 and 1947, respectively, and, after teaching at Worcester Polytechnic Institute for several years, joined the M.I.T. staff in 1951.

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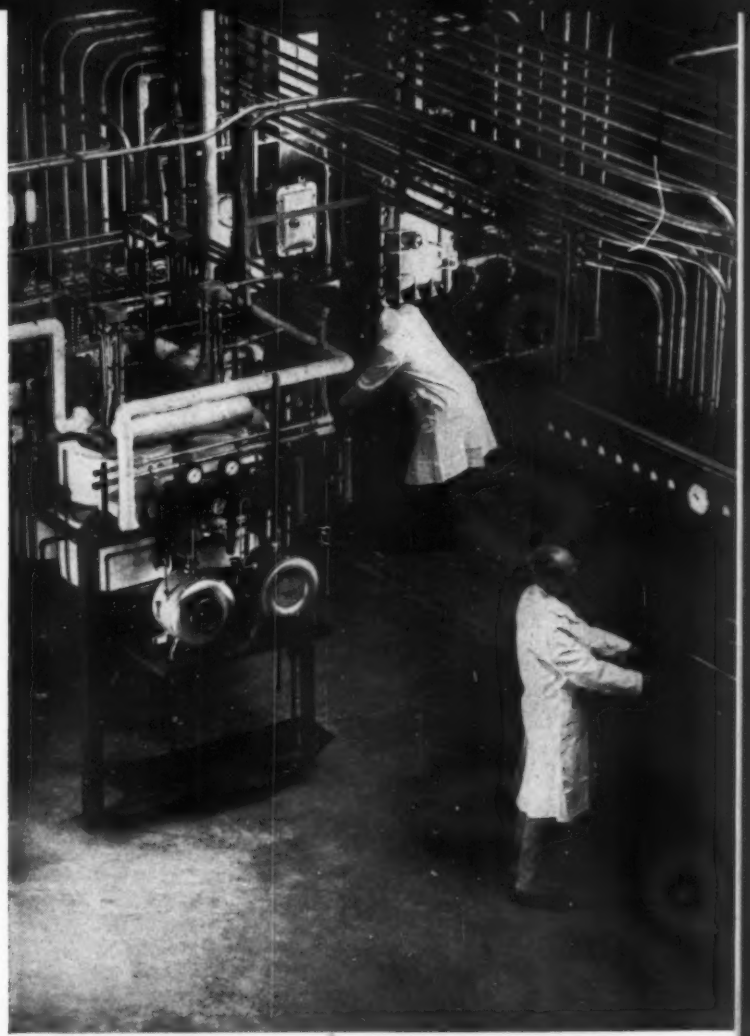

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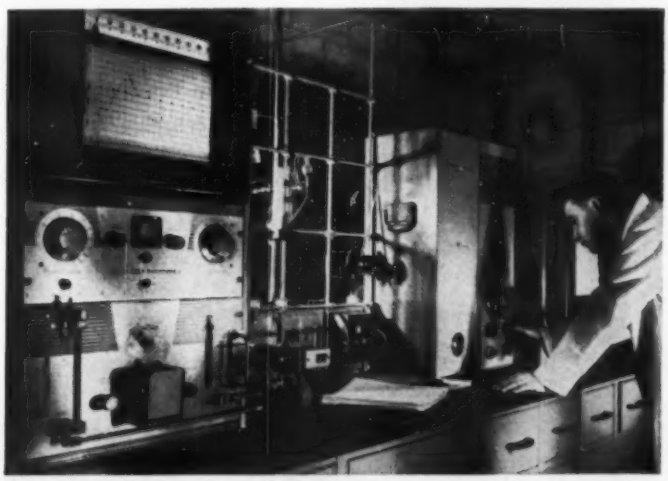

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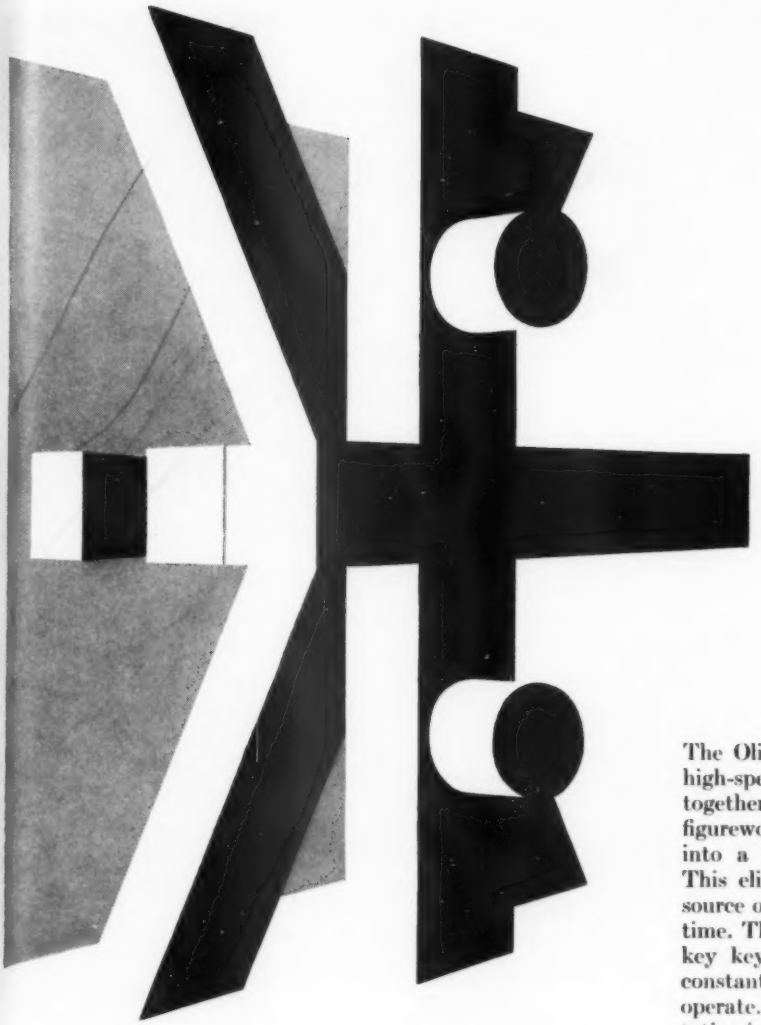

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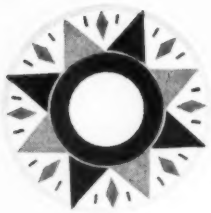

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# THE TECHNOLOGY REVIEW

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EDITOR:
B. Dudley

BUSINESS MANAGER:
R. T. Jope

CIRCULATION MANAGER:
D. P. Severance

EDITORIAL ASSOCIATES:
Paul Cohen
J. R. Killian, Jr.
F. W. Nordsiek
J. J. Rowlands

EDITORIAL STAFF:
Ruth King

BUSINESS STAFF:
Madeline R. McCormick

PUBLISHER:
H. E. Lobdell

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*Tug boat in harbor photographed for The Review by Raymond E. Hanson of Boston.*

*M.I.T. Photo*

## *Architectural Detail — Karl Taylor Compton Laboratories*

*This view of the Institute's newest facilities for teaching and research in the physical sciences shows a portion of the Compton Laboratories during the late summer. Chemical Engineering Building may be seen in background beyond throughway.*

The Technology Review

VOL. 60, NO. 1 NOVEMBER, 1957

# The Trend of Affairs

## Electrical Curriculum Studied

■ Professors of electrical engineering from more than 100 American colleges met at M.I.T. early in September and discussed a new plan for educating the next generation of electrical engineers.

According to Professor Gordon S. Brown, '31, Head of the M.I.T. Department of Electrical Engineering, the field of electrical engineering has been becoming more complex for decades. It no longer appears sound for students to specialize in narrow areas and to be taught about those areas by rigid formulas. The many modern advances in electrical technology require that students be more thoroughly grounded in the scientific aspects of electrical engineering than was deemed adequate prior to World War II. Electrical engineers who learned only to go to the handbook for recipes having to do with generators, transmission lines, or telephones are not prepared to cope with new developments, much less to contribute to them.

"Automation, the transistor, complex communication systems, a host of man-machine systems, the solar battery, and other new developments have been coming along," explains Professor Brown. "We believe that we should prepare students not only for electrical engineering as it exists today but to play a creative role in and to lead the electrical engineering of tomorrow," says Professor Brown.

As a result of this thinking, M.I.T. junked rotating machine laboratory equipment of limited flexibility which had been used for years, and substituted new apparatus which could be adapted by students for original creative work. For more than five years, professors in the Department have been revising the courses in electrical engineering and science. Since no textbooks existed suitable for use in the revised courses, new ones were written. It is estimated that 25 man-years of work went into the effort.

Graduates of the new Course VI program are now entering industry and graduate schools. The time was ripe, therefore, to have an over-all evaluation and criticism of the means and objectives of the M.I.T point of view by educators from the nation's colleges and universities.

With financial support from the National Science Foundation, M.I.T. organized the Curriculum Workshop in Electrical Engineering Education, which was held on September 4-13. It was expected that perhaps 50 professors from other colleges would attend the conference. But the response to a letter of invitation was so enthusiastic that more than twice that many, representing nearly as many institutions, attended the workshop sessions held in the lecture hall of the new Compton Laboratories.

Visiting faculty people were given a foot-high set of as-yet-unpublished textbooks prepared at M.I.T. They observed laboratory and classroom presentations and practices, and offered suggestions and criticisms on how engineering education can best meet the challenges of tomorrow's technology. Many visiting professors expressed enthusiastic interest in the new M.I.T. curriculum. Long after the scheduled daytime sessions were concluded, groups of these educators could be found conferring with their colleagues or trading their own experiences at Baker House, where the visitors were housed. Such experience is mutually beneficial in enabling Faculty members to benefit from M.I.T. experience and in further advancing teaching at the Institute.

Members of the M.I.T. Faculty who participated in the Cambridge meeting included: Ernst A. Guillemin, '24, Professor of Electrical Communications, whose specialty is circuit theory; Henry J. Zimmermann, '42, Professor of Electrical Engineering, and Samuel J. Mason, '47, Associate Professor of Electrical Engineering, who spoke on electronic circuits, devices and signals; Thomas F. Jones, Jr., '40, Associate Professor of Electrical Engineering, specialist in laboratory practices in circuits and electronics; Robert M. Fano, '41, Professor of Electrical Communications, and David J. Epstein, '49, Assistant Professor of Electrical Engineering, who discussed field theory and molecular engineering; David C. White and Alexander Kusko, 2-44, Associate Professors of Electrical Engineering, who dealt with electric energy conversion; and Lan J. Chu, '25, Professor of Electrical Engineering, and Richard B. Adler, '43, Associate Professor of Electrical Communications, speaking on energy transmission and radiation.

*Fay Foto Service*

*On the week end of June 7, the Class of 1907 celebrated its 50th reunion at the Oyster Harbors Club in Osterville, Cape Cod. The following 44 participants were photographed on that occasion which preceded their commencement and Alumni Day activities on the M.I.T. Campus: Standing (left to right) – Merton Sage, Bob Rand, Floyd Naramore, "Bebe" Hosmer, Ken Chipman, Albert Stevenson, Arthur Christensen, Tom Gould, Carl Bragdon, Ed Lee, Paul Cumings, Bill Coffin, Frank MacGregor, Gilbert Small, Stanley Wires, Ralph Hudson, Louis Freedman, "Molly" Scharff (M.I.T. '09), Parker Dodge, Hugh Pastoriza, Lester Brock, Maurice Pease, John Bradley, Jim Barker, and Milton MacGregor; Sitting (left to right) – Fred Dempwolf, George Griffin, Dick Ashenden, Bill Otis, Howard McChesney, "Kelly" Richards, Bob Albro, Bryant Nichols, Leverett Cutten (with the mace designed and made by him and presented by him on June 10, 1957, to M.I.T. as the gift of '07), John Frank, Mrs. Maude Darling Parlin (our '07 "coed"), Sam Marx, Don Robbins, "Hud" Hastings, Roy Lindsay, Harry Moody, George Crane, Phil Walker, and Allen Pope. Not present when the photograph was taken, but attending the reunion, were Cecil Baker and Henry Martin.*

## Olive Barnard: 1891–1957

■ During the summer, the sad announcement was received in The Review Office of the death of Miss Olive Barnard, technical assistant in the School of Industrial Management and honorary member of the M.I.T. Alumni Association. She died on August 28 at her home in Brookline.

Distinguished for her alumni relations during the past 38 years, she knew the names, faces, and job-histories of more than 3,500 former Course XV students. Miss Barnard joined the Department of Business and Engineering Administration in 1919 as secretary to Professor Edwin H. Schell, '12, and was an administrative assistant for more than 25 years. Since her retirement last June, when she was elected to honorary membership in the Alumni Association, she continued her position at M.I.T. on a part-time basis.

Miss Barnard is survived by two sisters – Mrs. Marjorie Parker of Goffstown, N.H., and Mrs. Helen Stafford of Rutland, Vt.

## Crew Coach

■ Appointment of Frank S. DuBois, Jr., as crew coach at the Institute was announced in August by Richard L. Balch, Director of Athletics. He succeeds James B. McMillin, '43, who came to M.I.T. as freshman crew coach in 1939 and has been head coach since 1945.

A native of New London, Conn., Mr. DuBois grew up on the shore of the Thames River, was a spectator at the Harvard-Yale race throughout his boyhood and was always interested in rowing. Bulkeley School, which he attended in New London, did not have a crew, however, and neither did the U. S. Merchant Marine Academy at Kings Point, N.Y., where he was graduated in 1946.

After serving at sea in the merchant marine for a year as a third mate, Mr. DuBois entered the University of Pennsylvania and learned to row as a freshman under Russell S. Callow. He was on the varsity lightweight crew for three years and was captain and stroke in his last year, 1951. That year the crew won the Eastern Association of Rowing Colleges sprint championships on the Charles River, the Thames Challenge Cup at Henley, and the Hamburg Regatta in Germany.

After receiving his B.S. degree from Wharton School of Finance and Commerce in Pennsylvania, DuBois was called into active duty for a year as a member of the Naval Reserve, first in Boston and then in Philadelphia. After his release from the Navy, DuBois returned to Boston and was employed by the John Hancock Mutual Life Insurance Company. He joined the M.I.T. staff in the fall of 1955 as coach of the varsity lightweight crew and in 1956 became freshman coach.

Mr. McMillin, a native of Seattle, rowed for four years at the University of Washington. He was captain of the crew which won the Olympics in 1936 and the 1937 crew which won the national championship. He was graduated with a B.S. in civil engineering, served as a first lieutenant in the Army and, during World War II, took a leave from M.I.T. to serve as a flight test engineer for Boeing Airplane Company.

Under McMillin's leadership, the M.I.T. lightweight crew won the Thames Cup in 1954 and 1955 and the E.A.R.C. sprint championships in 1954. The heavyweight crew won the sprints in 1950. In that year McMillin was president of the Rowing Coaches Organization of America. For the last six years he has been an engineer on the staff of Lincoln Laboratory.

## Donner Scholarships

■ Six prize scholarships totaling more than $13,000 have been awarded to six young high school graduates who entered the Institute this fall to study aeronautical engineering, it was announced last summer.

The prize scholarships have been established by Mrs. John Jay Ide of New York to honor the memory of her father, the late William H. Donner. This is the second year these scholarships, which are worth $2,200 each, have been awarded.

Given only to high school graduates who have shown promise of future achievement in aeronautics, the Donner scholarships are restricted to students planning to study in M.I.T.'s Course in Aeronautical Engineering.

Recipients for 1957-1958 are: David W. Baker of Great Falls, Mont.; Joseph T. Davis of Richmond, Va.; Elnathan Haskell of Columbia, S.C.; Peter F. Lindquist of Glen Ellyn, Ill.; Walter J. Wiegand, Jr., of New Britain, Conn.; and Byron H. Willis of Winslow, Ariz.

William H. Donner, for whom the awards are named, was noted for his many philanthropies in the fields of education and medicine. A steel executive, Mr. Donner also founded the towns of Monessen and Donora, Pa.

In his business career, Mr. Donner was successively manager of Donner Milling Company; manager and treasurer of National Tinplate Company, Anderson, Ind.; president of Union Steel Company, Pittsburgh, Pa.; president of Cambria Steel Company, Pittsburgh; chairman of the Board of Pennsylvania Steel Company; and president of Donner Steel Company, Buffalo, N.Y. At one time he was receiver of the Westinghouse Machine Company of Pittsburgh.

Mrs. Ide, who has established the scholarships, is the wife of John Jay Ide, who, for many years, was the European representative of the National Advisory Committee for Aeronautics at the American Embassy at Paris, France. Mrs. Ide's gift was inspired by the shortage of qualified scientists.

## Individuals Noteworthy

■ Recent honors have been presented to Alumni and members of the Institute's Faculty as listed:

To *Alfred P. Sloan, Jr.*, '95, an honorary doctorate of laws, by Columbia University . . . to *Arthur W. Carpenter, '13*, the 1957 Charles Goodyear Medal, the highest honor in rubber chemistry.

To *Professor Arthur L. Townsend, '13*, the 1957 James H. McGraw Award in technical institute education, by the American Society for Engineering Education . . . to *Edward P. Warner, '17*, the first honorary membership of the International Society of Aviation Writers.

To *Professor Arthur C. Hardy, '18*, the Frederic Ives Medal for 1957 by the Optical Society of America . . . to *Professor Harold C. Weber, '18*, the Army Chemical Corps' Certificate of Achievement.

To *Richard A. Wilkins, '18*, chosen as the first nonresident of the British Isles to be elected to its limited group of 12 Fellows, by the Institute of Metals . . . to *Robert H. Kean, '23*, the 1957 Distinguished Service Award for contributions to chemistry, by the Virginia Section of the American Chemical Society.

To *J. A. Stratton, '23, Chancellor*, an honorary doctorate of laws, by Northeastern University, and an honorary doctorate of science by St. Francis Xavier University, Antigonish, Nova Scotia; also recipient of a Certificate of Award by the Secretary of the Navy for distinguished public service to the U. S. Navy . . . to *George W. Rigby, '28*, an honorary doctorate of science, by Willamette University.

To *R. B. Woodward, '36*, an honorary doctorate of science, by Harvard University . . . to *David V. Ragone '51*, the 1957 award as an "outstanding engineer," by the Engineering Society of Detroit.

To *Professor Samuel C. Collins*, an honorary doctorate of science, by the University of North Carolina . . . to *Francis O. Schmitt*, Institute Professor and Professor of Biology, an honorary doctorate of science, by the University of Chicago.

■ Among the Alumni to whom birthday congratulations are appropriate during this month are four due to celebrate their 85th anniversaries, and seven their 80th, as listed below with their dates of birth:

November, 1872 – *Frederick L. Richards, '95*, on the 10th; *John A. McIlvaine, '96*, on the 17th; *Abram Garfield, '96*, on the 21st; and *Florence A. Ewing, '97*, on the 24th;

November, 1877 – *James C. Heckman, '00*, on the 4th; *Harold W. Jones, '98*, and *George H. Mead, '00*, on the 5th; *Everett F. Currier, '98*, on the 8th; *Edwin Kuttroff, '98*, and *George B. Moody, '00*, on the 10th; and *Lewis J. Seidensticker, '98*, on the 15th.

With these 11, the rolls of the Alumni Association will include a total of 57 living nonagenarians and 591 octogenarians.

### On the Horizon

*November 18, 1957* – M.I.T. Club of New York will hold its annual Stein Presentation Dinner at the Hotel Biltmore in honor of C. George Dandrow, '22. James R. Killian, Jr., '26, President, will be the principal speaker. (Reservations may be obtained by writing to: M.I.T. Club of New York, Biltmore Hotel, New York City.)

*December 7, 1957* – 11th M.I.T. Alumni Regional Conference, Pittsburgh, Pa. (For further information, consult Thomas I. Stephenson, 3d, '45, Aluminum Company of America, Pittsburgh 19, Pa.)

*March 1, 1958* – 12th M.I.T. Alumni Regional Conference, Washington, D.C. (For further information, consult T. K. Meloy, '17, 3000 Arlington Boulevard, Falls Church, Va.)

*March 13-15, 1958* – 10th Annual Fiesta, M.I.T. Club of Mexico, Mexico City, D.F. (For reservations, consult Clarence M. Cornish, '24, Margaritas 139, Villa Obregon, Mexico 20, D.F., Mexico.)

*June 16, 1958* – 24th Alumni Day, 1958, M.I.T. Campus in Cambridge.

## Twenty-five Years Ago This Month . . .

■ The Review quoted from the address made September 26, 1932, by President Karl T. Compton to the entering Class of 1936. Emphasizing the vital importance of fundamental integrity in politics, business, and professional life – no less important today than 25 years ago – President Compton said:

"During the past two years," said Dr. Compton, "everyone has realized the need of economy. Industries and individuals have been forced to practice it in order to survive. Similarly, our government must practice it in order to survive, for the state is also subject to the same economic laws. Political candidates and organizations have preached and advertised economy in their platforms. Non-partisan organizations have pleaded and worked for it. The press has strongly advocated it. The public wants it.

"Yet, despite honest effort and political ballyhoo, what do we see? We see in many cases a pretense at accomplishment. I am informed, for example, that in one of the great municipalities in this land, the budget requests of the departments show economies totalling only a fraction of one per cent – and that is only in supplies and not in payroll – and that there has not even been any reduction in such departments as garbage disposal, whose amount of work has shown marked reduction during the depression.

"The situation I point to as illustrating political dishonesty is not the type which is punishable by law, but which is failure to perform according to the principles of high moral integrity and social service. Such acts by those in power, whether due to selfishness or cowardice, seriously undermine confidence in our government and are most dangerous threats to its stability.

"When this depression came upon us and sales fell off, many companies tried to beat the game by putting on the market a cheap line of goods made to imitate goods of high quality and sold at the pretense of a reduction of price. My economist friends tell me that business now realizes that this has been a boomerang and a mistake. The point is that in business, as well as in politics, a high ideal of integrity is a great asset to society. We should practice it ourselves and rally to the support of others who do likewise.

"In professional work there are an infinite variety of tests of integrity, ranging all the way from temptation to dishonesty in specifications, or taking advantage of a client while advising him, to the results of an almost unconscious lack of precaution."

■ Congratulations were being extended to *Rear Admiral Emory S. Land, '07,* the new chief of the Navy's Bureau of Construction and Repair; . . . to *Kenneth T. Bainbridge, '25,* for having succeeded in measuring to an extraordinary degree of accuracy the weight of the recently discovered hydrogen 2, the heavy hydrogen atom; . . . and to *William B. Lodge, '30,* for his invention of an ultra short-wave transmitter which could send television images and sound simultaneously on the same wave lengths. His invention was termed "double-modulation."

## Alumni Fund Scholarships

■ This year the M.I.T. Alumni Fund received the largest total of gifts in its entire history. The $640,000 given to the M.I.T. Fund this year surpassed by nearly $70,000 the previous Fund high of $574,000 set in 1956. The 12,000 contributors also represented a new high in individual participation.

It is the third year in a row that receipts in excess of $500,000 have been reported by the M.I.T. Fund, and for the second consecutive year part of the Fund will be used for student scholarships.

The first announced use of this year's Fund money has been the awarding of Alumni Fund National Scholarships to 23 promising young high school graduates to enter M.I.T. this fall. The recipients of the four-year scholarships are:

Alfred T. Anderson, 3d of St. Petersburg, Fla., Michael L. Cooke of Glen Ellyn, Ill., Dorsey C. Dunn of Weatherford, Okla., Thomas L. Geers of St. Louis, Mo., George W. Gladfelter of Tucson, Ariz., John Hamilton of Oklahoma City, Okla.

Robert L. Johnsen, Jr. of La Jolla, Calif., G. Hunter Jones of Danville, Va., Anthony J. Joy, Jr. of Youngstown, Ohio, Raymond B. Landis of Sea Island, Ga., Robert B. McLean of Kansas City, Kansas, Claude R. Phipps, Jr. of Ponca City, Okla.

Thomas A. Schuck of New Hartford, Iowa, William M. Shaw of Amherst, Mass., Thomas O. Sherman of Garden City, N.Y., Uldi Shvern of Philadelphia, Pa., Nelson W. Stefany of Maplewood, N.J., Michael E. Stone of Minneapolis, Minn.

Alan J. Stratton of Helena, Mont., Craig S. Tedmon, Jr. of Seattle, Wash., Paul M. Tedrow of Storrs, Conn., David S. Wiley of Troy, Ohio, Joseph P. Wright of Huntington, W. Va.

## Decade of Co-operation

■ A unique international adventure in educational co-operation celebrated its 10th anniversary on August 30 with the closing exercises of the M.I.T. Summer School of Geology at Antigonish, Nova Scotia. Sponsored jointly by the M.I.T. Department of Geology and Geophysics and the Province of Nova Scotia, over the past decade this unusual school has helped educate some 350 young Canadian and U.S. geologists who have added new knowledge of the geology and geological resources of Nova Scotia.

Professors from M.I.T. and from Nova Scotia universities instruct a group of 25 to 30 students each summer in field training in geology and associated sciences at the Nova Scotia Center for Geological Sciences at Crystal Cliffs. The project, which is administered by M.I.T., also carries on a program of student thesis work and staff research.

Largely through the Department of Mines and to some extent through the Nova Scotia Research Foundation, the Province of Nova Scotia provides lodging, food, and transportation for the students.

Students from four Nova Scotia schools—Acadia University, Dalhousie University, Nova Scotia Technical College, and St. Francis Xavier University – have an equal opportunity with M.I.T. students to

*(Concluded on page 78)*

# Karl Taylor Compton — the Scientist

**Tribute to a former scientist, educator, and college president on the occasion of the dedication of new laboratories of science**

**by GEORGE R. HARRISON**

I LIKE to think of the dedication of these laboratories today as the further fulfillment of one of Karl Compton's fondest dreams, not because the laboratories are being named after him, but because this is the kind of place in which he would have chosen, if he could, to spend his working life. Giving up personal participation in scientific research at the age of 43 was a personal sacrifice that he was induced to make only because of his ever-active sense of duty.

There have been many discussions at M.I.T. as to how the name of Karl Taylor Compton could best be perpetuated in some tangible memorial. Suggestions have been made that dormitories be labeled "Compton House," or that we have a "Compton Auditorium," for there has been a natural desire to keep constantly before future generations the name of this great Institute personality. But no suggestion has been so appropriate as that now being carried out, for nowhere can the spirit of Karl Compton be more constantly and vitally felt than in a laboratory of science.

The official title of this building is the "Karl Taylor Compton Laboratories," but I predict that it will be called that only on the official record and on the labeling plaque. Soon, and we are hearing this already, it will be called the "Compton Labs," and students and Faculty alike will be talking about working in Compton, just as they now work in Eastman, or as they went over to Rogers in the old days, or over to Jefferson at Harvard, or Palmer at Princeton. This affectionate terminology is what marks the transition of an edifice from a laboratory building to a laboratory, from a house to a home of science. We owe it to Karl Compton's memory to make this a great home of science, and you may rest assured that this will be done.

There are two reasons why I presume to speak so positively regarding Karl Compton's reactions to this building. First, I have lately been gathering materials for his biography and have been growing up vicariously with him, sensing from letters, photographs, and records of his experiences, his joy and anticipation in a budding scientific career. Second, I have actually experienced this dedication of a science laboratory before, with him as the leader and most active participant.

Soon after the Comptons arrived at M.I.T. in 1930 I had the privilege of working with President Compton in the design of the George Eastman Research Laboratories of Physics and Chemistry which have in the intervening quarter of a century become so important to the functioning of the Institute. In those days, of course, the Institute was far smaller than it is now, and the then President was much less occupied by external affairs than he became later. Many were the long meetings with the architects that Dr. Compton, Professor John C. Slater as Head of the Physics Department, Professor Frederick G. Keyes as Head of the Chemistry Department, and I as Director of the Laboratory of Experimental Physics, spent in going over the blueprints. How much Karl Compton enjoyed this is testified by two papers he wrote for scientific journals on the layout of the new laboratories. You will find in *Physics* for April, 1932, an article entitled "New Spectroscopy Laboratory of the Massachusetts Institute of Technology" by Karl T. Compton. This laboratory, a small 13-room building in the court behind Eastman, resulted from an interchange of letters between Dr. Compton and myself as to where in the projected new George Eastman Laboratories a room could be provided that would be 40 feet on a side, without any obstructing columns, for the installation of special apparatus.

Again, in *Science* for May 6, 1932, we find an article by Karl Compton entitled "The George Eastman Research Laboratories for Physics and Chemistry." He begins this paper by saying, "These new research laboratories are built in the belief that these fundamental sciences are destined to play an even more important role in our civilization than they have played in the past. For not only do they underlie all branches of engineering, but they are necessary to that sympathetic understanding and appreciation of modern life which is so important a part of present-day culture." The features he mentions as being especially built into the new laboratory were rigidity and freedom from vibration, flexibility and completeness of electrical service, flexibility of internal arrangements, unusually adequate shop, lecture room, and departmental library facilities, and provision for encouraging cultural and artistic and social contacts amongst staff and students. He quotes from the plaque in the entrance lobby which contains a quotation from Virgil, translating it as "Happy is he who has been able to learn the causes of things, and has cast beneath his feet all fears of inexorable fate and the roar of greedy Acheron." One nostalgic note that I can bring from those departed days is that that building, with its volume of 1,367,000 cubic feet, cost $1,146,000 or $0.83 per cubic foot. If you do not know offhand the comparative figures for today, rejoice and be exceeding glad.

In working on Dr. Compton's biography, I sometimes am worried about what to call him in a par-

ticular context. Much of the time, of course, he must be President Compton, while on family outings he is obviously Karl. Today I have no such difficulty. To the physicists of America, from the time soon after the beginning of his scientific years at the Palmer Physical Laboratories in Princeton, he was known as K.T. However, this use of initials did not arise in the manner customary when underlings want to be slightly informal with the boss, but don't want to be fired for overfamiliarity. It started out to distinguish Karl from A.H., his brother Arthur Holly Compton, also a physicist, but there came to be much more to it than this. During the twenties, K.T. developed for himself a special place in the hearts of all physicists, and there was an affection in this diminutive which went far beyond the combination of mere familiarity and respect.

Most of you have probably heard what happened over in Room 10-250 when Professor Scherer of Zurich gave a series of lectures in experimental physics at the Institute, soon after Dr. Compton became president. K.T. was always very modest about his scientific achievements, and was especially careful never to appear, even by accident, to take any of the credit for his brother's major discovery, a phenomenon in x-ray scattering which threw new light on collisions between photons and atoms and became known as the "Compton Effect." I have never heard Karl refer to it as the Compton Effect, but only as "my brother's effect." I do not know quite how to describe the way he said this — it was a quiet pride in the achievement of the brother five years younger than himself, whom as a youngster he used to carry around on his shoulders and refer to affectionately as his "sack of flour."

Professor Scherer had occasion in one of his lectures to refer to the Compton Effect. Many members of the Faculty were in attendance, a number of them, I am sure, to see how their new president would preside, and when the Compton Effect came up I could see some of the engineers nodding and smiling to each other as if to say, "See, this is a discovery of our new scientific president." Professor Scherer observed this, also, for he stopped suddenly in his demonstration, raised his hands and said, "No! No! Zees Compton Effect, she is not Kah Tay. Zees is Ah Ha!"

*Members of the Compton family who attended dedication ceremonies of new laboratories in the physical sciences last June were: Mrs. Karl T. Compton, and brothers Wilson Compton (left) and Arthur H. Compton (right).*

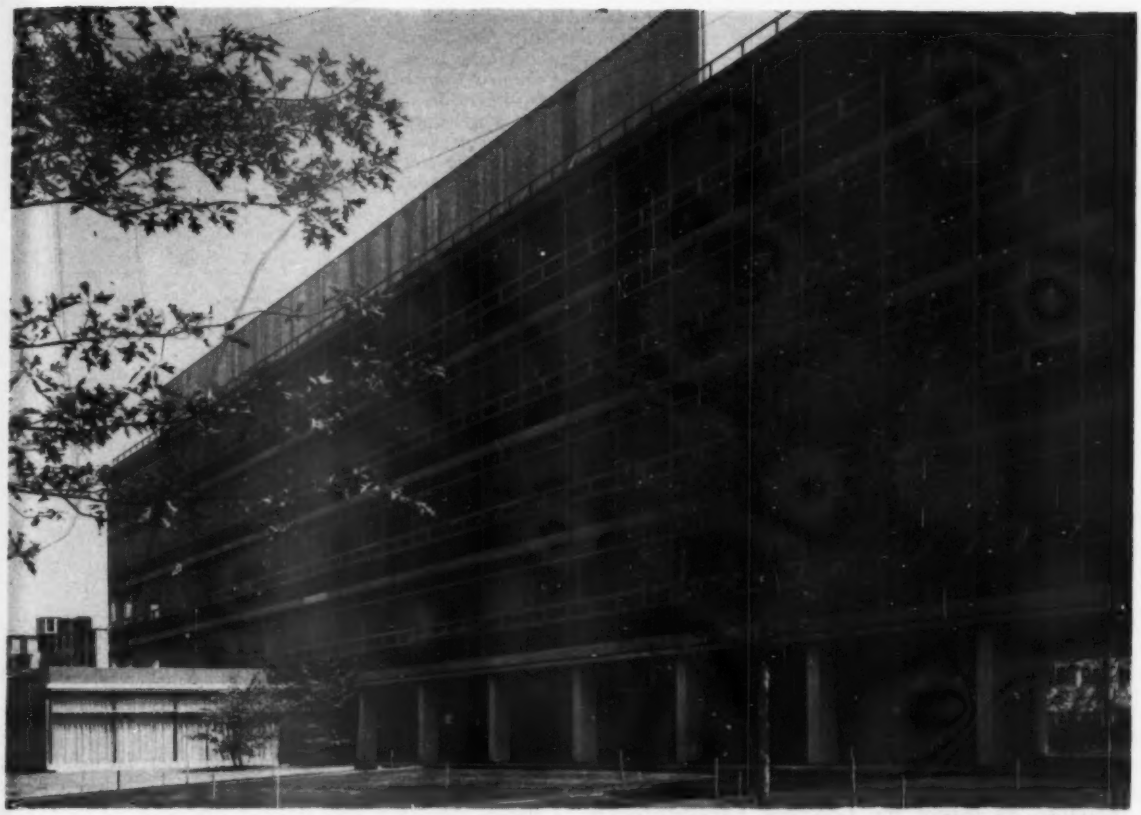
*M.I.T. Photo*

Every room in the Eastman Laboratory was carefully planned by K.T. in consultation with his department heads (those were the dear dead days before the deans), first to fit in with what the occupants of the various bays desired, and then to perfect a unified design for an outstanding scientific laboratory. I remember particularly the discussion we had about the physics and chemistry shops. A ukase had come down from Samuel W. Stratton, then chairman of the Corporation, who had until Dr. Compton's arrival been president of the Institute and still maintained a very active part in its direction, that the Physics and Chemistry Departments were to have a single joint shop. This produced the same kind of violent reaction in my breast, and in some others, as a similar suggestion on my part recently produced in scientific breasts when I made the same suggestion in connection with the present laboratories.

Dr. Stratton had been responsible for the setting up of the shops at the National Bureau of Standards, and scientists there complained vigorously of the amount of red tape they had to go through in order to get any piece of scientific apparatus built, since they were required to put in a formal blueprint of any piece of apparatus desired, and would not see it again until the apparatus was delivered some months later. Pieces of new research equipment being designed by a physicist or chemist are likely to be improved as they take shape, and the professor and the mechanician must work closely together, the one on the backs of old envelopes, and the other at his milling machine. Furthermore, chemists use a different kind of plumbing from physicists and have their own peculiar ideas as to where nuts and bolts belong. So John Slater and I went to Karl Compton with our problem. He said, well, Dr. Stratton had given orders that there was to be a single shop, but he didn't see any objection if we wanted to put a row of shelves down the middle of the large shop area to separate the chemistry and physics sections. The shelves were put there, Dr. Stratton was fortunately nearsighted, and they have stood firm and substantial for the past 25 years. As Robert Frost says, "Good fences make good neighbors," and the two shops have dwelt side-by-side in the most peaceful co-operation and friendliness.

I still think of that line of shelving, as opaque and impervious a wall as anyone could ask for, as being a monument to Karl Compton's understanding, diplomacy, and foresight. Almost every day I look at this "Compton Line" with much benefit to myself. An administrator sees very forcibly the desirability of maintaining a minimum number of shops and libraries, and using common shop and library facilities for as large an educational entity as possible. K.T. knew from his own experience, and by example taught me to remember, the importance of getting books and tools as close as possible to where they can be used.

*(Continued on page 70)*



*Photos — M.I.T. Photographic Service*

*View of the Karl Taylor Compton Laboratories, looking north from the Chemical Engineering Building. Computation Center is in single story structure at left; throughway, to Alumni Pool, at right.*

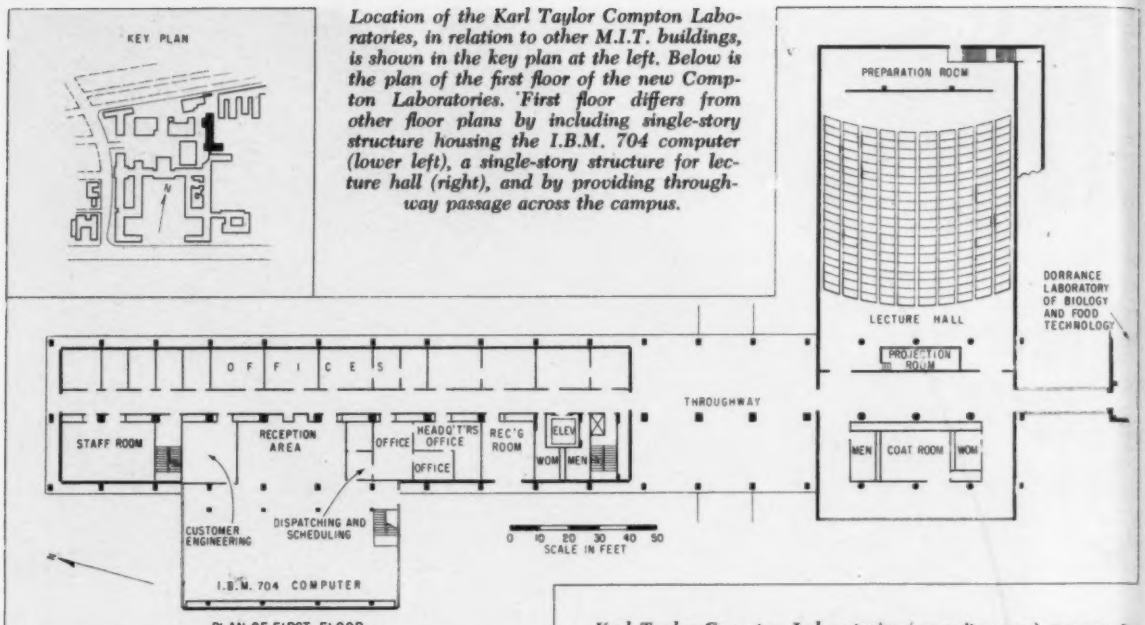
# New Science Facilities

**The Karl Taylor Compton Laboratories, and a nuclear reactor, are the Institute's newest facilities for advancing teaching and research in the whole broad field of the physical sciences**

THE Karl Taylor Compton Laboratories building, together with the M.I.T. nuclear reactor now nearing completion, represents the newest additions to teaching and research facilities at the Institute. Both facilities will be used primarily to house research projects in the physical sciences but because of the close alliance between teaching and research, both may be regarded as educational. The Compton Laboratories will be the central home for the Research Laboratory of Electronics, the Laboratory for Nuclear Science, the new M.I.T. Computation Center, and a group of Faculty members engaged in studies in theoretical physics. Placing the headquarters of the Research Laboratory of Electronics and the Laboratory for Nuclear Science in the new building will make the Compton Laboratories the hub of research work that extends throughout the world.

The $4,000,000 Compton building will add 148,000 square feet of floor space to the Institute's educational facilities, and was erected as a memorial to the late Karl Taylor Compton, former president and chairman of M.I.T. Of the total amount, $3,135,000 was raised through efforts of M.I.T. Alumni, including contributions of $1,000,000 each from Alfred P. Sloan, Jr., '95, and Irenee du Pont, '97. Under construction as a part of the same general program of research and education is a $2,400,000 nuclear reactor, now nearing completion on the M.I.T. campus.

It is anticipated that these new laboratories will provide for an effective symbiosis of the research and teaching phases of physics at M.I.T. The results of research very quickly find their way into teaching, even at the undergraduate level. For a decade the Research Laboratory of Electronics and the Labora-




*Location of the Karl Taylor Compton Laboratories, in relation to other M.I.T. buildings, is shown in the key plan at the left. Below is the plan of the first floor of the new Compton Laboratories. First floor differs from other floor plans by including single-story structure housing the I.B.M. 704 computer (lower left), a single-story structure for lecture hall (right), and by providing throughway passage across the campus.*

*Karl Taylor Compton Laboratories* (opposite page) *as seen ► from point near the Alumni Pool and looking in southeasterly direction. Lecture hall is low structure at left foreground, with Dorrance Laboratories in the rear.*

tory for Nuclear Science have operated at the forefront of current physical knowledge. It is logical, therefore, to expect the Compton Laboratories to foster education and research in the physical sciences, much as Karl Taylor Compton accomplished this aim during his life.

It is intended that the Compton Laboratories will house other research activities as these develop in importance. One indication of the constant change in research is the recent establishment of the M.I.T. Computation Center. This new and important facility was added to the present structure after it was initially planned. M.I.T. has pioneered in the development of computers and computing techniques for many years. The mechanical and electronic forms of the Bush differential analyzer were put into use in 1927 and 1943, respectively. The network analyzer, cinema integraph, and other computing devices were developed in the early 1930's. Whirlwind I, the first digital computer to have a magnetic core memory such as is used in the I.B.M. 704, was built at M.I.T. and has been in use since 1950. Thus, the new Computation Center with its I.B.M. 704 computer represents another important step in the Institute's program of advancing science through development and application of large-scale computing devices.

Amid pleasantly landscaped surroundings, the Compton Laboratories building is a handsome, completely modern, five-story structure of reinforced concrete with exterior walls of aluminum, enameled metal panels, and glass. Some areas on the ground floor are faced with speckled gray or blue glazed brick. The exterior facing contains black panels of porcelainized steel under which a honeycomb paper structure is placed on a galvanized plate. Vermiculite separates the two metal plates to fill the honeycomb structure and to provide effective thermal insulation.

The building consists of five floors, a huge penthouse on its roof, well suited to the study of radar and cosmic rays, and a basement. It covers a ground area of 55 feet $\times$ 333 feet, not including an area of 74 feet $\times$ 44 feet on the ground floor in which the new computer is located, and an additional area 66 feet $\times$ 112 feet for a lecture hall. Windows divided by horizontal black panels extend the full length of the four upper floors. The glass windows have a green tint to reduce transmission of heat into the building. This tint is clearly evident from the outside, but is barely noticeable when looking from the inside toward outside.

The new laboratories are located in an area of the Cambridge Campus northeast of the dome of Building 10. They lie between the Chemical Engineering Building 12 and Building 24 (used as the Radiation Laboratory during World War II) on the west, and the Alumni Pool on the east. The building connects with the main group of M.I.T. buildings by a glass enclosed walk at five floor levels at a corner of the Dorrance Laboratory of Biology and Food Technology which, in turn, connects with Buildings 8 and 6. The new Compton Laboratories extend north almost to Vassar Street. For those who knew the Institute a decade ago, the Compton Laboratories replace a temporary wooden research laboratory erected during World War II and later used as a dormitory for veterans.

Plans for all floors of the Compton Laboratories are essentially the same, except at the ground level. The first floor is larger than other floors by the space taken for the lecture hall and by the Computation Center. On the first floor are the lecture hall, Computation Center, some offices (most of which are concerned with the Computation Center), and an entrance and

throughway. The open throughway separates the area of the lecture hall from rooms associated with the Computation Center. It provides access to both but it also provides an openness to the grounds so that the Compton Laboratories does not divide the campus in two. In the throughway, on an exterior wall adjacent to the lecture hall, is a simple, large black granite plaque bearing the name, Karl Taylor Compton Laboratories, as shown on page 40.

### Flexibility for Future Needs

In planning the Compton Laboratories, much care and attention have been given to provide as much flexibility as possible for future needs and expansion. It is recognized that a laboratory such as the Compton Building will house a variety of research projects, from time to time, having different requirements. One of the unusual features of the new building is that cables carrying electrical power at different voltages, phases, frequency and power ratings are run through it vertically rather than horizontally. This has been done so that equipment drawing considerable power can be used in any part of the building without stringing temporary cables through the corridors. Other service facilities (gas, water, plumbing lines, and so on) also rise from the basement for branch distribution on each floor. There is an electrical riser at the end of every bay, and a plumbing riser at the end of every second bay. So far as possible, electrical, plumbing, and other service lines have been stubbed off where not now needed, and can be quickly and economically brought into use when required.

The building is divided lengthwise along a center line. On the west side of the center plane are the classrooms and most of the laboratories. To the east side of the center line are the corridor, the offices, and the smaller laboratories. On the east side of the corridor are also the Document Rooms for the Laboratory for Nuclear Science and for the Research Laboratory of Electronics.

For the most part, single bay offices on the east side of the building are 9 × 16 feet in size; larger offices are multiples of this width. The rooms are free of columns or other obstructions, and larger rooms can be economically and easily divided into single bays when required.

An elevator is provided in the center of the building. It is about 8 × 8 feet in size and decorated in yellow enameled metal with fluorescent lighting around the ceiling. Adjacent to the elevator shaft are wash rooms and a staircase. A second staircase is at the north end of the building.

The first floor is divided into three major areas. That nearest the Dorrance Building is occupied by the Compton lecture hall. A separate one-story structure is used for this hall which seats 416 persons. The floor of the auditorium slopes down, and the speaker's platform and most, if not all, of the seats are below ground level.

Adjacent to the lecture hall is an open area or throughway which serves a double purpose. It provides entrance to the lecture hall and to the Computation Center and its offices, while also affording passage between campus areas on either side of the Compton Laboratories. Near the throughway a "time capsule" is deposited as recorded in the July, 1957, issue of The Review.

The third major area of the first floor houses the Computation Center (which, like the lecture hall, oc-

*View of part of the I.B.M. 704 computer units in the M.I.T. Computation Center, as seen from the Reception Area.*

cupies a separate structure one-story high), offices associated with the Computation Center, and offices for liaison between the Armed Forces and the Research Laboratory of Electronics. The first floor also contains a shipping room.

### Computation Center

The Computation Center is housed in a separate structure (about 74 feet × 44 feet) designed and built especially for the I.B.M. 704 computer and its associated equipment. This portion of the Compton Laboratories is air conditioned. The first floor contains three major rooms: the room holding the 704 computer (together with reception area); a programming room where material is programmed for the computer; and a customer engineering room which is staffed with I.B.M. personnel to keep the computer maintained and in proper order.

The new M.I.T. Computation Center will be one of the largest and most versatile data-processing facilities yet made available primarily for education and basic research. It was made possible through the cooperation of the International Business Machines Corporation who also installed the machine and will contribute toward the cost of maintaining and operating it for the use of M.I.T. and other New England educational institutions.

The program will mark the opening of a co-operative venture between the International Business Machines Corporation, M.I.T., and at least 23 other New England colleges to increase the number of scientists and engineers qualified to use modern computing machines, and to learn more about their application to research problems in many fields. The Center also will be used for instruction and research in management science.

The I.B.M. 704 computer occupies the major part of the first floor area of the computer wing. The 23 machine units making up the computer proper rest on a rubber tile floor under which there are steel flooring plates, but there is a 14-inch space between the steel plates and the floor proper of the computer building. This 14-inch duct is used for cables needed for interconnecting the equipment, and for air ducts for cooling the computer units. Considerable power is required to operate the machine, and the tubes used generate a good deal of heat which must be adequately dissipated. Two walls at the end of the computer building are double-walled thermopane glass. The west wall, nearest Building 24, is acoustically treated, as is the ceiling. In back of some of the acoustic treatment are panels for electric service facilities, and temperature and humidity controls.

A false ceiling of open grid work is suspended from the main ceiling. In this two-foot duct are fluorescent lamps for shadowless, overhead illumination, and ducts for the air conditioning.

The basement below the 704 computer contains an Electrical Accounting Machines Room for the preparation of tape and for other requirements for servicing the computer. This room is devoted to the punching of cards and other preparations needed to keep the 704 machine fed with data needed for its operation. All of this equipment is auxiliary to the computer; it serves to keep the computer performing as it should, but does not enter directly into computer operations beyond those functions associated with programming.

### Lecture Hall

A major unit of the Compton Laboratories, on the first floor, is the lecture hall which will be used for

lectures and demonstrations for large groups. The auditorium is a large, well-lighted room, free of columns or other obstructions to seeing or hearing. In size it is 66 feet × 112 feet and is divided into two separate sections. The smaller of these is the stage, containing lecture and speaker's tables, and a new type of hydraulically operated, enameled metal "blackboard." The larger portion seats approximately 416 persons in chairs and school desks designed for rapid access. Seats are arranged in pairs and each seat is an "aisle seat" so that students can enter or leave without crossing in front of other persons.

The seats are arranged at two different slopes. The first nine or 10 rows have a gradual slope, whereas the rear 11 rows have a steeper slope. This construction allows those in the rear to see over the heads of persons sitting in front of them, so all may have an unobstructed view.

The room is constructed of concrete, and steps are covered with rubber mats. The walls are of concrete or brick, with plaster facing. There are no windows or other breaks in the walls which have an undulating surface for proper acoustics. The ceiling is acoustically treated, below which rows of cold cathode lamps provide uniform illumination. The rows of cold cathode lamps are seperated, at about two-foot intervals, by birch strips.

Lecture facilities at the front portion of the room include a concrete platform, about one foot high and 51 feet × 8 feet. A large lecture and demonstration table is provided for conducting experiments; this is provided with gas, air, electricity, and similar facilities. A separate speaker's table or lectern is provided. Behind the lecturer, the double-walled, hydraulically operated blackboards are easily visible from any part of the auditorium. Overhead lamps provide illumination of high intensity and uniform distribution for the blackboard, whether the main ceiling lights are on or off. Above the speaker's table, at ceiling height, is a loudspeaker for distributing sound from a public-address system. This is useful for speakers with small voices or when the room is fully occupied, although average speech can be well understood without too much reinforcement by electrical means.

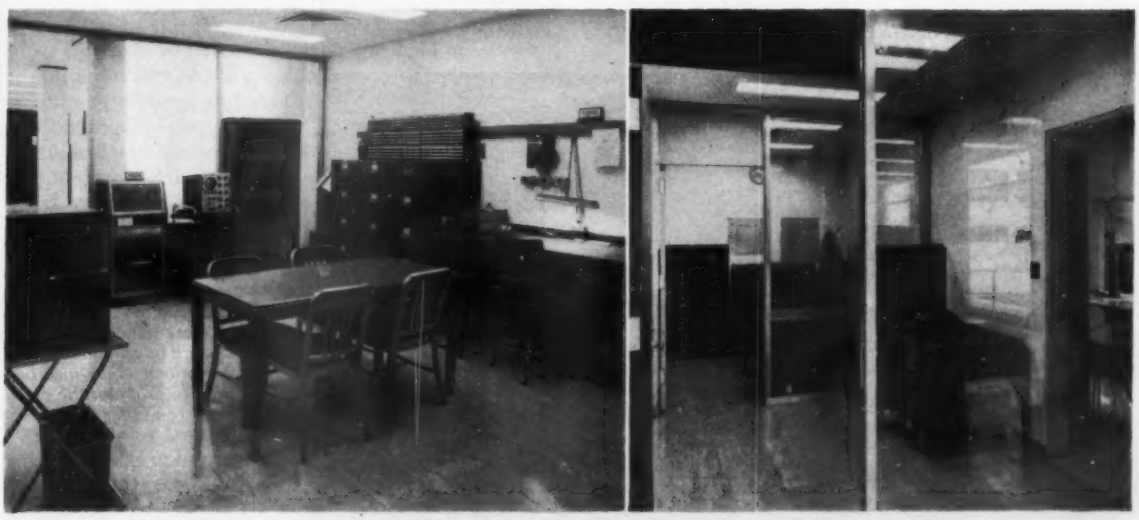
Behind the instructor's table is a blackboard 48 feet wide. This can be supplemented by three 16-foot blackboards which can be raised or lowered hydraulically. A 12 × 16 foot motion picture screen can also be raised or lowered electrically at the front of the lecture hall.

At the side walls, near the speaker's platform large rectangles of white material may be used for projecting illustrations on the side walls. These panels may be turned at a 45-degree angle with respect to the side wall. This is especially useful when the results of demonstrations are to be projected. An exit, to the right of the audience, is provided, and a clock is on the opposite side of the room.

A Preparation Room is in back of the blackboards. This contains bays of steel racks housing laboratory apparatus needed for demonstration lectures for first- and second-year physics students. Lecture tables can be prepared in the Preparation Room and wheeled onto the lecture platform already set up, in a few moments.

The lecturer controls all lights and a demonstration table is provided with gas, water, electric power, and other services as may be needed. Lights for room illumination, blackboard illumination, operation of blackboards, operation of screen for projection, can be controlled from three different positions: (1) the lecturer's desk; (2) the Preparation Room; or (3) the Projection Room.

A film projection room (28 × 8 feet) extends across the rear of the hall, above and behind the students' heads. It provides ample space for all kinds of projectors and television cameras. The ceiling of the hall has been made of birch flooring, recessed for continuous cold cathode lighting. Panels can be removed from this ceiling to permit the lowering of a gondola for additional cameras or a large-screen television projector if this proves to be desirable.



*Adjoining the Reception Area in the Computation Center is a combination office and laboratory for Customer Engineering* (left), *and two smaller rooms devoted to the dispatching and scheduling of programs for the 704 computer.*

*Technical operations relating to the use of the computer are handled in this office of the Computation Center, on the first floor of the Compton Laboratories.*

Outside of the lecture hall will be found wash rooms, drinking fountain, fire alarm box, and fire hose. Public and M.I.T. telephones are near at hand, and a check room can accommodate 525 persons. All lights in the corridor are from the ceiling. Floor is of Dextone, with walls of brick tile in two colors, yellow and speckled gray.

### Facilities on Other Floors

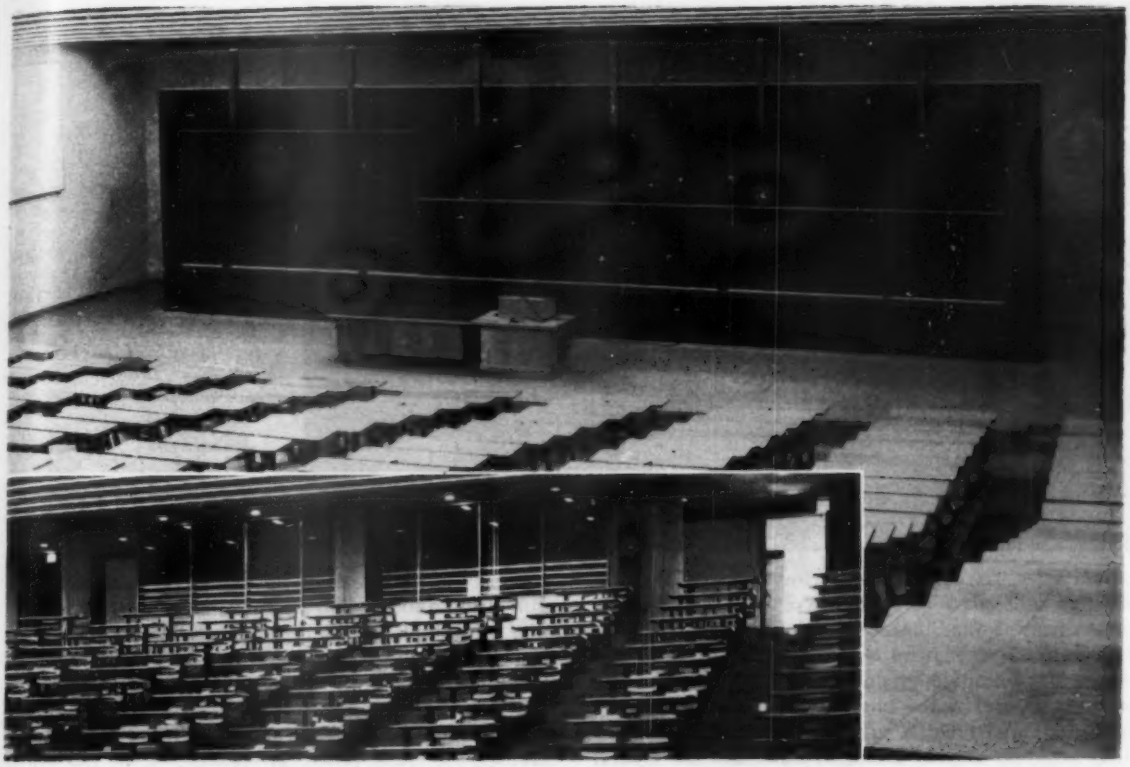
Approximately one-fifth of the floor area of the second floor is occupied by the offices, conference rooms, and library of the Computation Center. Rooms associated with the computer are located at the north end of the building where they are in proximity to the 704 I.B.M. computer on the first floor and the card punching and auxiliary services in the basement.

The rest of the second floor houses activities of the Research Laboratory of Electronics. Headquarters and a business office are located adjacent to the elevator in the center of the building. Offices, conference rooms, seminar rooms, and classrooms occupy the rest of the second floor.

There are four classrooms on the second floor, and four on the third floor. The classrooms seat 42 persons in cast-iron and birch-top desks accommodating two or three students. Four of these classrooms are provided with special light-tight aluminum Venetian blinds which can be closed well enough to darken the room for projection of slides or motion pictures. The classrooms are also provided with electrical conduit facilities so that they can be used for future television programming should this later prove to be a desirable educational activity. They connect with television conduit facilities which have been installed in the auditorium and can be put to immediate use when television invades the classroom.

The third floor is occupied by the Research Laboratory of Electronics. Here are the headquarters, business administration office, and document room for R.L.E., a shop and, as already noted, students' classrooms.

*In the basement of the Compton Laboratories, directly under the I.B.M. 704 computer units, is the Electrical Accounting Machines Room for punching cards and handling similar auxiliary operations which may be required to program the new computer.*



*Lecture hall in the Karl Taylor Compton Laboratories. The larger view shows the lecture hall as normally seen by students, with 48-foot blackboard — a portion of which may be raised electrically. White panel at left may be swung to 45-degree angle and used for projecting pictures from speaker's table. The insert shows the lecture hall as seen by lecturer, with exits on each side of the glass-enclosed Projection Room.*

On the fourth floor are the headquarters, library, document room, and seminar room for the Laboratory for Nuclear Science. The fifth floor is also occupied by the Laboratory for Nuclear Science.

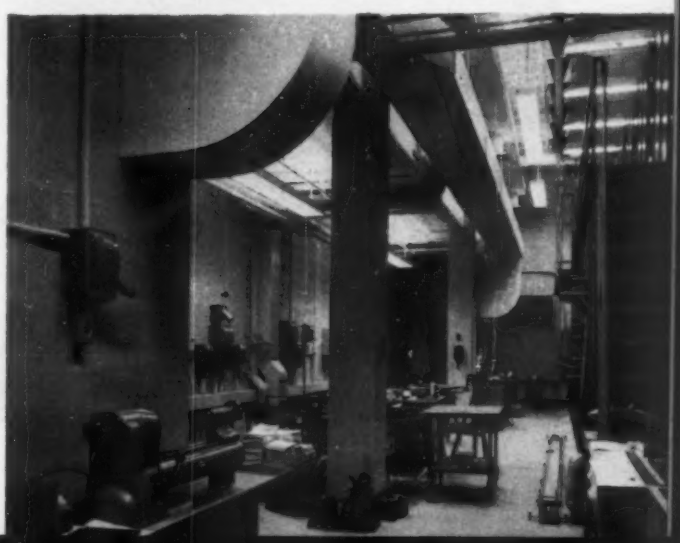
The penthouse contains a large laboratory room which overlooks Cambridge and Boston, and which is well suited to the needs of radar or cosmic ray research where unobstructed view is an asset. The penthouse exterior is faced with anodized aluminum. In addition to the large laboratory space, the penthouse contains one room housing the cooling tower for chilling water of the condensing unit for the computation laboratory, and another cooling tower for air conditioning the lecture hall. Another room houses mechanical equipment to provide blowers for classroom and corridor ventilation. The penthouse is designed to stand 100 pounds per square foot.

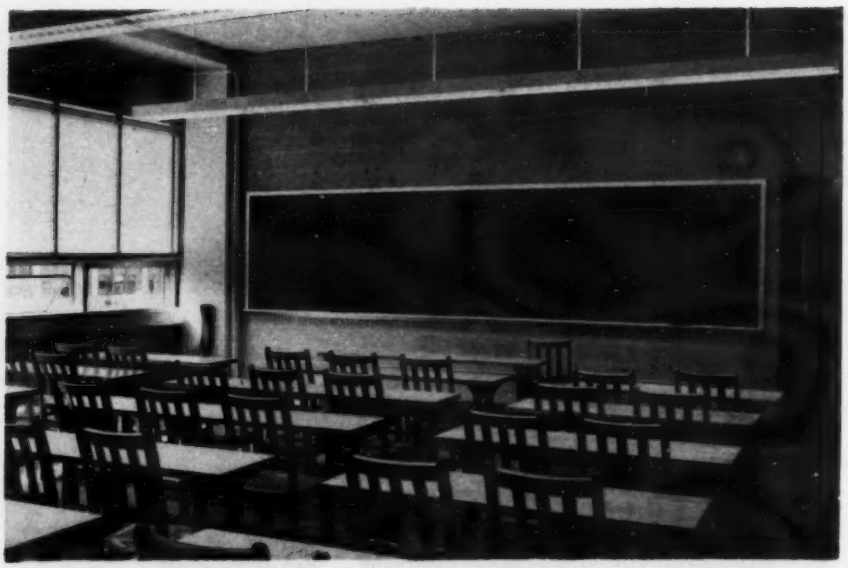
### General Services

The basement will be shared by: (1) the Computation Center; (2) the Laboratory for Nuclear Science; (3) the Research Laboratory of Electronics; and (4) Physical Plant Department. It contains service equipment and provides for distribution of all services. Power comes in from the Cambridge Electric Company at 13,800 volts, three-phase system, and is distributed in a three-phase, four-wire, 208-volt system through the laboratories. Power of 1,500 kilowatts comes into the laboratories, exclusive of that used by the Computation Center. Two power panels are employed, each handling 750 kilowatts of power. It is possible to take a load from either of these units (up to the limit of 750 kilowatts) or to take power from both units simultaneously. Should failure of the primary source of power occur, interconnections can be made to take power on an emergency basis from the Dorrance Laboratory.

A battery and generator room contains storage batteries and special generators (such as a 400-cycle generator) to supply the laboratories with special electrical facilities. In several rooms throughout the

*Preparation Room, in back of blackboards of lecture hall, used for setting up experimental apparatus for physics lectures.*





*One of eight classrooms in the Karl Taylor Compton Laboratories. This room is typical of other classrooms, and can seat 42 persons. Special close-fitting Venetian blinds can be adjusted to darken the room for projection of still or motion pictures.*

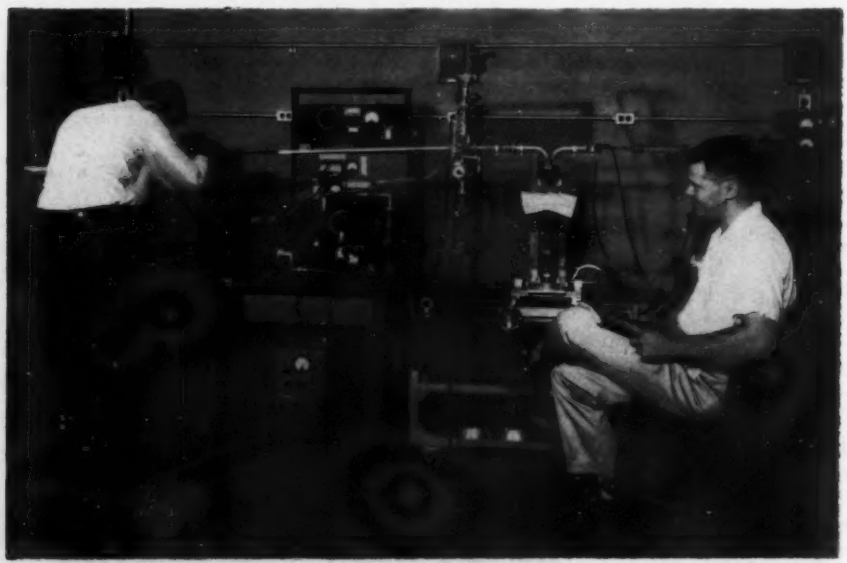
laboratories, six copper conductor bars of 1,000,000 circular mils area carry low voltage, high-current power from storage batteries in the basement to laboratories, such as that for the molecular beam studies, where low voltage, high-current D-C source of power is required. Below the basement, a conducting grid, buried in moist earth when the foundations were dug, provides a good ground connection for several laboratory rooms.

The basement also contains space for mechanical equipment for air conditioning. Two air-conditioning units are used below the room housing the 704 computer. One of these is used to condition the computer elements. The second air-conditioning unit is used to condition the air circulating generally around the room. A great deal of care has been taken to prevent the computer from operating if the air-conditioning units become inoperable. Hence, should the compressors or other air-conditioning units fail, interlocks will act to shut off power to the computer cabinets until proper environmental conditions are restored. A power of 225 kilowatts is needed to operate the computer, and another 300 kilowatts is used to air condition the rooms in which the computer equipment is located. Altogether the computer requires 100 tons of air-conditioning equipment.

The mechanical service room also contains interlocks for fire-protective apparatus so that in event of fire, all electrical power is removed from the computer, whereas fans are set into operation to purge the rooms of noxious gases that usually arise from burning electrical apparatus or equipment.

The architects of the Karl Taylor Compton Laboratories were Skidmore, Owings and Merrill of New York, and Gordon Bunshaft, '33, of that organization was most helpful. The contractor was the George A. Fuller Company of Boston and New York. Construction of the building has been under way for more than two years, and moving the two interdepartmental laboratories into it took most of the summer.

Alumni may well be proud of the role they – and industry – have played in establishing this memorial



*Typical laboratory in the Karl Taylor Compton Laboratories building devoted to research in the physical sciences.*

*Document Room of the Research Laboratory of Electronics, on the third floor of the Compton Laboratories, contains thousands of periodicals and reports dealing with recent progress in electronics and closely related subjects.*

to a beloved former president of M.I.T. Many were present for the dedication ceremonies on Alumni Day, June 10, including Alfred P. Sloan, Jr., '95, who gave $1,000,000 to the memorial and was instrumental in first suggesting that the new laboratories be named for Dr. Compton. Alumni have furnished two rooms in the Laboratories – the John Picker Kolker Room, given by Leon A. Kolker, '31, in memory of his son, and a room donated by George E. Merryweather, '34, given in the name of his Cleveland firm, the Motch and Merryweather Machine Company. Thomas J. Watson, Jr., President of the International Business Machines Corporation, and a special term member of the Institute's Corporation, set the 704 computer in operation on Alumni Day. Substantial support has also come from Du Pont, [Edwin S.] Webster, and Kresge Foundations as well.

### Nuclear Reactor

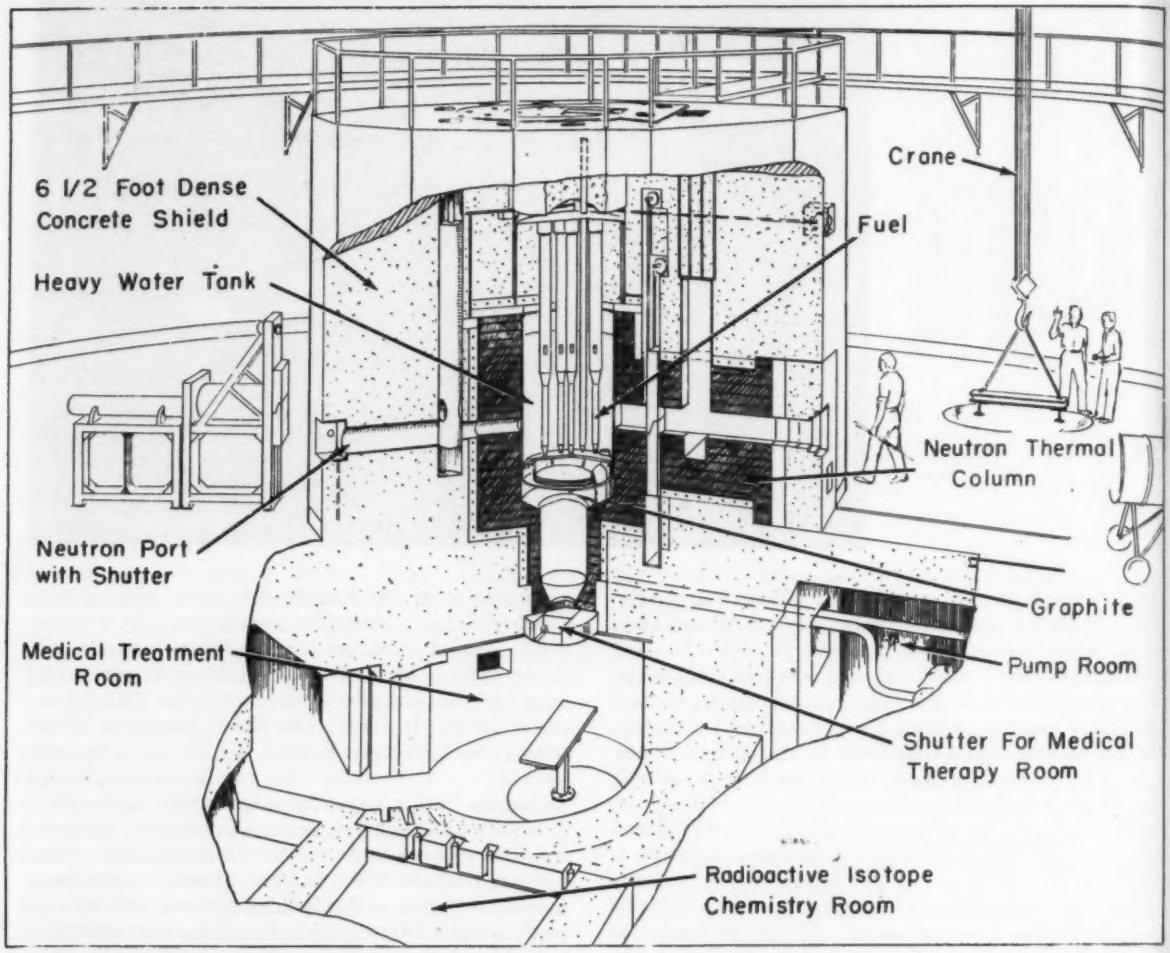
Although not part of the Compton Laboratories, the nuclear reactor now nearing completion in Cambridge is another excellent example of the advanced research facilities that are being established at the Institute to emphasize the complementary aspects of research and education. Research reactors, such as that now being built at M.I.T., are finding increased application in advanced education in nuclear science and engineering, as well as in nuclear research and development. A research reactor is a reactor built primarily for advancing knowledge of the physical world, rather than for producing power or radioactive materials.

Since the M.I.T. reactor is intended as a tool for research and education, two significant factors were kept in mind throughout the period of planning and design. First of all, the reactor should be readily accessible to the Institute Faculty and also to other medical, industrial, and educational agencies in Metropolitan Boston. This has been achieved by locating the reactor in Cambridge on Albany Street, west of Massachusetts Avenue. The reactor is in proximity to M.I.T. laboratories and is near a main thoroughfare of Cambridge and Boston.

The second consideration in building a reactor adjacent to the campus was the problem of safety, and every possible consideration was given to this responsibility of the Institute. The M.I.T. reactor is of the heavy-water-moderated kind which is inherently among the safest reactors that can be built. Although its capital cost is somewhat higher than other kinds of reactors, the heavy-water-moderated type provides for irradiation of larger volume of material than other kinds of reactors. Thus, in terms of useful experimental information obtainable from it, the $2,400,000 cost of the reactor is reasonable. Capital costs were minimized by designing the reactor as simply as possible, without unnecessary ornamentation or accessories.

Two main uses planned for the M.I.T. reactor are to advance the Institute's program of graduate education in nuclear engineering, and to support a varied program of research. It is in an unclassified area and

*Typical single-bay office in the Compton Laboratories is strictly functional and utilitarian, but pleasantly conducive to intellectual endeavors.*




*This cutaway drawing shows the general construction of the M.I.T. nuclear reactor now nearing completion in a cylindrical steel structure on Albany Street near Massachusetts Avenue. The fuel element (center) is surrounded by a tank of heavy water, graphite, and concrete shielding. A room on the lower level is for medical research. Every effort has been taken to provide for flexibility of research needs, combined with maximum safety.*

will be used for unclassified research and teaching. The reactor will be used as a principal facility in a nuclear engineering laboratory course. It will also be employed to teach engineers and scientists the theory, design, and operation of nuclear reactors; techniques for production, handling, and measurement of neutrons, gamma radiation, and radioactive materials; and the principles and applications of reactor instrumentation.

In addition, the variety of nonclassified research projects which can be carried out with the aid of the reactor will be of inestimable value in the instruction of graduate students and Faculty members in many of the Institute's departments. Such research includes neutron diffraction studies (a valuable new technique for investigating the structure of materials); the use of neutron beams in developing improved methods for treating brain tumors and other cancers by neutron beam therapy; production of short-lived radioisotopes for research studies in the Boston area; radiochemical studies; promotion of chemical reactions; activation of engineering and test materials; food processing and sterilization; study of mutations; and reactor engineering studies.

The reactor consists of two structures. One of these is a cooling tower through which heavy water is circulated for cooling. The reactor building is a cylindrical steel shell, 70 feet in diameter, with a steel dome rising 50 feet above street level.

All entrances to the reactor building are of the air-lock type, with pressure locks on the doors. The building is automatically sealed if radioactivity is released. A 20-ton crane on a circular track, around the circular concrete shell, services the experimental area within the building. Between the reactor shell and the outer walls, a clear work area, 25 feet across, is provided. A concrete-framed entrance is provided for trucks to deliver or remove experimental material.

The reactor building will be air conditioned. Air entering the building will be dehumidified and its temperature will be maintained at between 70 degrees and 75 degrees F. Two circuits of A-C power at 110 volts and 220 volts are provided for experimental apparatus. In addition, compressed air, cooling water, and vacuum lines are provided.

Most of the experimental work will be done on the first floor where provision is made to conduct as many

(*Continued on page 80*)

# President's Annual Report

**Outstanding teachers are regarded as the top priority in a report which stresses the importance of increasing student scholarship funds as well as of Faculty salaries**

**by JAMES R. KILLIAN, JR.**

A MASTERFUL and penetrating analysis of the problems confronting higher education in the United States is contained in the ninth annual report which President James R. Killian, Jr., '26, presented to members of the M.I.T. Corporation at their meeting on October 7. While Dr. Killian's remarks obviously are primarily concerned with matters affecting the successful operation of M.I.T., the policies and activities of the Institute are reviewed "in their relation to the national setting." It is inevitable, therefore, that much of Dr. Killian's report deals most significantly with major problems of higher education – particularly in the field of technology – wherever they may be encountered in the United States.

In capsule form, Dr. Killian believes that the more immediate goals to strive for, to assure the Institute's continued leadership in higher education, are: (1) to increase Faculty salaries (which have not kept pace with those of industry or even with inflation); (2) to increase the teaching effectiveness of the Faculty by all possible means; (3) to encourage outstanding college graduates to embark on teaching careers and to make teaching careers as attractive and lucrative as industrial careers; and (4) to increase scholarship and loan funds so that no intellectually endowed student need be denied a college education for economic reasons.

In emphasizing that teachers constitute the top priority in the nation's educational objective, Dr. Killian compares M.I.T.'s aims with those set forth, for the nation as a whole, by President Eisenhower's Committee on Education Beyond the High School. President Killian says:

> The Second Report of President Eisenhower's Committee on Education Beyond the High School, published in July, 1957, affords us an interesting opportunity to examine our policies, priorities, and needs in the light of the recommendations of this Committee. Let me select those items from the Committee's report (italics) which are relevant to a private institution such as M.I.T. and briefly summarize how we stand in relation to them.

### Teachers — The Top Priority

*The Committee recommends to every board of trustees . . . (1) that the absolute highest priority . . . be given to raising faculty salaries, . . . with particular attention to increasing the spread between the bottom and the top . . . (2) that action also be taken to provide at moderate cost such benefits as health and life insurance, etc.*

In M.I.T.'s financial planning and current fund raising, we give top priority to finding the means to increase faculty compensation. In the past five years the average salary of our assistant professors has been increased 15.5 per cent, that of full professors 15 per cent. We have thus achieved modest gains, but these are not enough. (The President's Committee recommends doubling the current national average in the decade ahead.)

We are now raising a wasting fund to finance selective salary increases introduced this year and to provide for additional increases. Mr. Sloan [Alfred P. Sloan, Jr., '95], through the Sloan Foundation, has offered to grant M.I.T. up to $1,250,000 for this salary fund, provided the Institute obtain $3,750,000 to provide a total of $5,000,000. The Corporation has accepted the challenge of this generous and most timely offer. Under the chairmanship of our fellow Corporation member, Walter J. Beadle, '17, we have now launched a special and concentrated drive to raise at least the $3,750,000 needed to obtain the full amount from the Sloan Foundation – and, we hope, to exceed this total to offset continuing inflation and to help on our long-term needs.*

The Institute's salary scale is relatively good compared with other major universities and is substantially higher than the national average; but our main competition now comes from industry. We have been engaged in many rear-guard actions to hold valuable members of our staff who are offered industrial salaries far higher than we can pay. Even more distressing is the difficulty we have in attracting enough able young graduates to elect academic rather than industrial careers.

We share the sense of urgency of the President's Committee. If our effort to raise a wasting fund to be spent over five years is successful, we can take an unconventional and bold step to raise compensation. Insuring the future strength of M.I.T. requires and justifies our doing so.

*The Committee urges the faculty of every college and graduate school to join . . . in a nationwide effort to recruit undergraduates and graduates of high talent for college teaching.*

Except in a few fields, the number of our graduates electing teaching careers continues small in comparison with the need. Only 28 of our 170 doctor's degree re-

* Mr. Beadle has associated with him the following regional vice chairmen: Oliver L. Bardes, '21, of Cincinnati, Charles A. Chayne, '19, of Detroit, Francis J. Chesterman, '05, of Philadelphia, Cecil H. Green, '23, of Dallas, Robert C. Gunness, '34, of Chicago, Homer V. Howes, '20, of St. Louis, H. W. McCurdy, '22, of Seattle, Antonio H. Rodriguez, '21, of Havana, William C. Sessions, '26, of Cleveland, David A. Shepard, '26, of New York, William J. Sherry, '21, of Tulsa, Raymond Stevens, '17, of Cambridge, William L. Stewart, Jr., '23, of Los Angeles, and Irving W. Wilson, '11, of Pittsburgh.

M.I.T. Photo

*Simple granite plaque marks the entrance to the Institute's newest laboratory facilities in the physical sciences. The Karl Taylor Compton Laboratories building, dedicated on Alumni Day, June 10, now houses the headquarters of the Research Laboratory of Electronics, the Laboratory for Nuclear Science, and the Institute's new Computation Center. Classrooms and a lecture hall are included in the new building named in memory of the Institute's ninth president.*

cipients last year have gone into college teaching. The attractions of industrial jobs, especially in engineering and the sciences, are too great. I see evidence of improvement; but I also see the need for more systematic encouragement of students to elect teaching careers in our national system of higher education. It is indeed true, as the Committee observes, that "high-powered recruiters descend upon campuses these days for nearly every career but teaching."

Our major contribution to augmenting the supply of teachers is to be found in the growth of our Graduate School, which is, of course, our chief training ground for teachers. Since 1950 our annual enrollment of graduate students has risen from 1,675 to 2,500. We are thus preparing more men and women with the qualifications to teach, provided they can be attracted into academic careers. Through teaching assistantships, of which we have about 270, we also give graduate students exceptional opportunities to learn, through apprenticeship, the art of teaching; and we diligently seek to attract from our own graduate student body candidates for our own junior staff. . . .

The President's Committee observes, *"Great good for all higher education might come from the establishment of a few highly experimental new colleges which could test out radically new methods of achieving better utilization of faculty and space, unfettered by traditional campus practices."* We believe that M.I.T. has a responsibility to experiment and test out radically new methods, doing this within our existing framework.

Last month our Electrical Engineering Department, with funds provided by the National Science Foundation, held an eight-day "Workshop" attended by professors of electrical engineering from 104 engineering colleges in the United States and Canada, for the purpose of discussing and evaluating the extensively modified and upgraded electrical engineering curriculum we are now teaching. This conference may prove to be profoundly influential in shaping the future course of engineering education.

*The Committee urges all educational institutions to continue to devise ways by which their available faculty may teach more efficiently. . . .*

I can report a fresh and growing preoccupation with the effectiveness of undergraduate teaching and a realization that more experimentation in the art of teaching can yield important gains in efficiency and effective learning. We can do much by encouraging our students to take, as the Committee suggests, *"more responsibility for their own education through greater reliance on independent study and less on daily instruction of teachers."* We also might well give more systematic attention to relieving skilled teachers from routine tasks, freeing them to concentrate on more important and difficult teaching functions, and *"to adapting different class sizes to accommodate more efficiently the various objectives of learning."* In remarking on these recommendations, I hasten to point out that M.I.T. has gone far in providing supporting services to its teaching staff. I emphasize, too, that our whole educational philosophy is to provide quality education; our emphasis is on educational effectiveness and the highest standards rather than on economic efficiency (although we seek that, too, so long as it is compatible with quality).

### The Need For Assistance To Students

*The Committee urges that individual colleges and universities seek to expand the use of loans, in combination with other forms of student aid. . . .*

Under the leadership of Gerard Swope, '95, M.I.T. established a large loan fund in 1930. Since that time we have lent $4,000,000 to 5,000 students. Of the students who have borrowed, 98.4 per cent have paid back their loans on time – at the rate of $50 every six months following graduation. These loans bear an interest rate of 1 per cent, and this rate covers all defaults several times over. Thus not only does the fund revolve, but the corpus of the fund has also been slowly growing. In fiscal 1957 we will lend about $500,000 to our students, both graduate and undergraduate. . . . While aversion to borrowing is an admirable quality in certain circumstances, so too is the willingness of a young man to bet on himself and his future. It is a frequently observed fact that parents who express objections to borrowing money for education will readily borrow money in order to purchase a host of family luxuries. This represents a curious inversion of values. . . .

*The Committee finds that presently available scholarships are grossly inadequate . . . recommends that private, local, and state sources increase their support of scholarship funds to several times the present amount*

*and number of scholarships . . . that scholarships should include (when feasible) provision of funds for the institution . . . to pay for the cost of educating the student above what he pays through fees and tuition.*

While the Institute has had a gratifying increase in scholarships available to its students and has benefited greatly from the growing national scholarship programs financed by industry and foundations, we still find ourselves short of needed scholarship assistance for both undergraduates and graduates. We estimate that over the next 10 years we should add, on the average, about $1,000,000 per year to our endowment funds for scholarships and fellowships. As national and regional scholarship assistance grows, the funds available to individual institutions should also grow. Each institution needs the flexibility that comes from scholarships under its own control. . . .

Private institutions, as they improve faculty compensation and meet rising costs of operation, will inevitably have to increase student fees; but this cannot be done unless student aid is also increased. This relationship between tuition policy and student aid is recognized by the President's Committee when it recommends *"that charges to students in private institutions in general be gradually increased in order at least to maintain the proportion of total costs paid by students; and that programs of student assistance be stepped up to support increases in tuition and other charges."* This is M.I.T. policy. . . . At present, the M.I.T. tuition covers less than half of the Institute's educational costs; *every* student automatically gets a "scholarship" larger than the tuition he pays. . . .

The Committee recommends an experimental federally supported work-program for students. The idea that students be given the opportunity to help themselves by working is very sound, and M.I.T. makes jobs an integral part of its student aid program. In fact, we have more jobs for students than we have takers. For our kind of academic environment, we have no need for a federally supported program. Student earnings at M.I.T. now total over $400,000 a year, exclusive of salaries paid to graduate students holding assistantships.

### Admissions

*The Committee does not agree with those who argue that, in order to preserve quality, colleges must sharply restrict enrollments to something like their present level by boosting admissions standards. . . .* We are not yet in any danger of pushing academic standards too high in the United States; in fact, even those institutions with the greatest selectivity in admissions have probably not achieved student bodies of the intellectual maturity and capacity of some European institutions, although our students are superbly able.

We at M.I.T., despite our high selectivity, feel that we are not admitting as many superior students as we would like, and I suspect other institutions of high selectivity feel the same way. . . . In the last decade we have nearly doubled in size, with most of the increase coming at the graduate level. M.I.T. has thus responded to the growing needs of the nation for scientific man power. At present we are trying to stabilize our enrollment, in order to permit our resources to catch up with our growth and thus to insure the continuing excellence of our education. . . . The ultimate capital cost of adding one additional student is in excess of $50,000. The President's Committee observes that *"if an unwelcome choice were required between preserving quality and expanding enrollments, then quality should be preferred because it would do neither individuals nor the nation any good to masquerade mass production of mediocrity under the guise of higher education."* . . .

### Financing Higher Education

*The Committee recommends that each existing institution, if it has not already done so, undertake immediately an intensive and imaginative study of its long-range goals and plans. . . .*

In planning our financial program and the development of our campus buildings, we are now

1. Formulating a five-year budget so that we can properly anticipate changing financial needs.

2. Preparing a carefully integrated development program for the next 10 years.

3. Starting, with the assistance of competent architects and city planners, a searching study of building planning and land utilization. We do this not only to have a carefully thought-through plan for our own needs but also properly to relate our planning to the program of planning and urban renewal in the city of Cambridge.

4. Proceeding with a long-range program to improve student housing facilities, with the benefit of the comprehensive study of student housing made in 1956 by the Corporation Committee on Student Housing (the Ryer Committee). . . .

In discussing the recommendations of President Eisenhower's Committee, I have of course omitted many items. Some of the report is not relevant to M.I.T., and the Institute has many problems and interests which are not reflected in the report. For example, the Committee does not deal with the great questions of educational content. Nevertheless, I hope that this discussion throws light on how Institute policy accords and differs with the findings of this important and thoughtful report by representative American citizens; and I hope that this M.I.T. report is in the spirit of the recommendation *"that institutions give appropriate publicity, aimed at the general public, to their major sources of educational and general income and objects of expenditure so that there will be more awareness of the real costs of education . . ."*

### The Year In Review

From a long list of important advances, modifications, and achievements of the past year, I select the following for special mention:

1. The trend toward flexibility in our undergraduate programs is reflected in modifications made in several undergraduate curricula. The Department of Chemical Engineering has adopted a new program which greatly increases the choices of subjects available to students by replacing many requirements with electives in the upper years. The new Course vests in the student greater responsibility for planning his future; it allows him increased flexibility in preparing for graduate specialization in a variety of fields, including nuclear engineering and biological engineering as well as chemical engineering.

The Civil and Sanitary Engineering Department is experimenting with a curriculum which introduces students as early as their sophomore year to serious professional problems; we thus seek to relate the basic analytical work . . . to its professional context.

The Electrical Engineering Department has continued its development of a greatly changed and upgraded undergraduate program in electrical engineering, involving the introduction of more science into the curriculum. The Department has introduced a new Course, Electrical Science and Engineering, for a highly selected group of students. This new curriculum is of five years' duration and represents an effort to integrate undergraduate and graduate work in a Course unbroken at the end of four years. It leads to the bachelor of science and master of science degrees, awarded simultaneously.

The Mechanical Engineering Department has established a new optional curriculum in the field of nuclear

power engineering in co-operation with the Nuclear Engineering Division of the Department of Chemical Engineering.

The Physics Department has devoted special attention to making undergraduate laboratory work more effective and to providing more opportunities for independent and creative work.

In the School of Humanities and Social Studies, a Political Science Section has been formed to afford a better integration of our teaching and education in this field in the core curriculum.

2. We have widened and deepened our educational and research activities in the earth sciences. Recognizing that meteorology is growing more quantitative and thus requires more and more preparation in the physical sciences, our Department of Meteorology has abandoned its undergraduate curriculum and now concentrates on graduate study. The undergraduate curriculum in the Department of Geology and Geophysics is now well planned to provide an undergraduate education broad and basic enough to prepare students for specialization in meteorology and other earth sciences at the graduate level. Finally, the Departments of Meteorology and of Geology and Geophysics have combined to sponsor the Laboratory of Earth Sciences, of which Professor Henry G. Houghton, '27, is director. This Laboratory will widen and co-ordinate our educational and research activities in geology, geophysics, meteorology, and oceanography. All of these activities are strengthened by a co-operative arrangement with the Woods Hole Oceanographic Institution.

3. Under the joint sponsorship of the Schools of Architecture and of Humanities and Social Studies, elective courses are now available in the visual arts. These will provide an opportunity for students actually to participate in studio work and will also include lectures, seminars, and field trips, to gain an intimate acquaintanceship with and understanding of the visual arts.

4. The School of Industrial Management has steadily moved away from the descriptive teaching of the components of business toward analytical approaches to the problems of management.

5. Under the direction of Professor Jerrold R. Zacharias, assisted by Professor Francis L. Friedman, '49, the Institute has drawn together from both colleges and secondary schools a group known as the Physical Science Study Project, to plan a new approach to the teaching of physics in the secondary school. New experiments and experimental equipment are being devised, with emphasis on simplicity and inexpensiveness. The educational motion picture is being searchingly restudied, and efforts are being made to give it new effectiveness and integrity as a teaching tool. A new text is being written and supplementary manuals on various aspects of physics are being prepared for publication. . . .

### Some Educational Problems and Opportunities

Throughout the Institute there is ferment, self-examination, and experimentation, especially in the field of undergraduate education; and as our curriculum changes and evolves, we encounter a range of difficult problems. A growing number of engineering students wish to increase the content of physics and mathematics in their engineering programs. It appears that we are moving toward a condition where engineering undergraduates will normally study an average of three years of physics and mathematics. (Some of our Courses now prescribe only two.) This growing emphasis on basic science reflects the trend toward a more fundamental and generalized undergraduate curriculum in engineering. . . .

### Sponsored Research

Through the various projects of the Division of Sponsored Research and of all our campus laboratories, we provide unusual educational opportunities for graduate students to participate, under faculty supervision, in research at the frontiers of their respective fields. Faculty participation contributes to the timely introduction of new developments into the academic curriculum, and members of the full-time research staffs associated with these sponsored research projects receive advanced training under outstanding leadership before assuming professional responsibilities in government and industry.

We try always to make as sure as we can that this association brings the maximum benefit, through the years, to the educational process. We are accordingly selective in the research we undertake. The work must hold promise of importance, and it must be in fields in which the Institute has exceptional competence and which are relevant to our mission. . . .

A significant part of Dr. Killian's report is devoted to the changes in personnel that have occurred at M.I.T. during the past year. In nearly every case, the more important of these changes have already been reported in the pages of The Review, and are therefore omitted in this condensation.

An important part of President Killian's report dealt with new research and educational facilities, and is presented in condensed form as follows:

### New Facilities

During the year, the Institute moved forward with important new additions to our resources for education and research. Alumni Day, June 10, witnessed the dedication of two of these facilities: the Karl Taylor Compton Laboratories and the Computation Center. . . .†

In order to supplement existing housing facilities for women students at 120 Bay State Road in Boston, we have converted one section of Bexley Hall on Massachusetts Avenue into an apartment dormitory. The Institute can now provide housing for 50 women students.

In addition to completed projects, three other major facilities are now under construction. This winter will witness the completion of a $2.4 million nuclear reactor, which will be one of the most versatile constructed anywhere for research and teaching purposes. Under the direction of Professors Manson Benedict, '32, and Theos J. Thompson, it will give new impetus to our rapidly growing program of study in the field of nuclear engineering.†

This spring, ground was broken for a six-billion-electron-volt accelerator for basic research in high-energy particles. This facility, located on the Harvard campus, will be built, managed, and utilized jointly with Harvard University. It will be completed in about four years, at a cost of $6.5 million.

This fall we will begin construction of the David Flett du Pont Memorial Athletic Center on the West Campus. The du Pont Memorial Center will provide 12 new tennis courts, an $800,000 building adjoining the Armory to provide supplementary facilities for intercollegiate sports at M.I.T., six squash courts, facilities for women, and a locker room for faculty members. These facilities have been made possible by the $1 million bequest of David F. du Pont, '56, who met tragedy in an automobile accident in 1955.

*(Concluded on page 78)*

†A description of these new additions to M.I.T. teaching and research will be found beginning on page 29 of this issue.

# Second Alumni Officers' Conference

**Some 350 alumni officers and M.I.T. officials review recent progress in the Institute's educational and research programs and discuss ways in which Alumni can further M.I.T. objectives**

**A TECHNOLOGY REVIEW REPORT**

ACTIVITIES of the school year opened at M.I.T. on September 6 and 7 with a conference planned especially for Class and Club Officers, Alumni Fund Officers, Honorary Secretaries, and members of the Educational Council. This second Alumni Officers' Conference (the first was held in the fall of 1955) was designed especially to bring these groups of "working Alumni" up to date on M.I.T. plans and programs. Approximately 350 men attended the two-day meeting which reviewed recent progress in education and research at the Institute and featured a series of workshop sessions on topics of special concern to each of the attending groups.

Speakers on the general program included: Gilbert M. Roddy, '31, President of the M.I.T. Alumni Association; James R. Killian, Jr., '26, President of M.I.T.; Vannevar Bush, '16, Chairman of the M.I.T. Corporation; and George R. Harrison, Dean of the School of Science. Other Alumni who played leading roles in the conference included: William L. Taggart, Jr., '27, Chairman of the Conference Committee; D. Reid Weeden, Jr., '41, Vice-president of the Alumni Association; Whitworth Ferguson, '22, Avery H. Stanton, '25, and Alf K. Berle, '27, – all members of the Alumni Fund Board.

Speaking on educational progress at M.I.T. on Friday morning were: J. A. Stratton, '23, Chancellor; H. Guyford Stever, Associate Dean of the School of Engineering; and John T. Rule, '21, Dean of Students. On Friday afternoon, President Roddy spoke on Alumni participation in M.I.T. activities and President Killian reviewed some of the current problems which M.I.T. must solve. Saturday morning was devoted to a discussion of some recent developments in research at M.I.T. Speakers included: George R. Harrison, Dean of the School of Science; Charles S. Draper, '26, Head of the Department of Aeronautical Engineering and Director of the Instrumentation Laboratory; Nathaniel H. Frank, '23, Head of the Department of Physics; and Jay W. Forrester, '45, Professor of Industrial Management. The addresses were given in the lecture hall of the new Karl Taylor Compton Laboratories described in this issue (page 32).

In addition to the workshops and general speaking sessions there were also a number of social events, including a reception early on Friday evening at the home of President and Mrs. Killian. A highlight of the conference was the presentation of Bronze Beaver Awards "for distinguished service" to several clubs and individuals at the dinner on Friday. Recipients of 1957 Bronze Beaver Awards were:

1. Bryant Nichols, '07, who, as reunion chairman of his Class, led it to an outstanding record on the occasion of its 50th reunion;

2. Orville B. Denison, '11, who, as Class Agent

*Photos — M.I.T. Photographic Service*

*The "welcome sign" is out at Kresge Auditorium as Alumni officers, honorary secretaries, and others start the school year with serious discussion of M.I.T.-Alumni relations* (left). *Those taking part in the session Friday morning, September 6, are (left to right): J. A. Stratton, '23, Chancellor; William L. Taggart, Jr., '27, chairman of Conference Committee; John T. Rule, '21, Dean of Students; and H. Guyford Stever, Associate Dean of the School of Engineering.*

*Conference attendees serve themselves lunch in the Campus Room of the Graduate House.*

sinee 1940 and Class Secretary since 1911, has established a record of service without peer;

3. Donald B. Gilman, '32, who, as reunion gift chairman of his Class, led it to an outstanding record on the occasion of its 25th reunion;

4. The M.I.T. Club of Northern New Jersey for its study of the factors affecting the growth and influence of an M.I.T. Club;

5. The M.I.T. Club of Oklahoma for its outstanding regional conference which was hailed as "one of the most significant meetings in Tulsa history";

6. The Alumni of Cranston, R.I., who, under the chairmanship of William H. Barker, '32, achieved a perfect record of participation in the 1957 Alumni Fund.

7. The Alumni of Rochester, N.Y., who, under the chairmanship of Frederick J. Kolb, Jr., '38, established an outstanding record of participation in the 1957 Alumni Fund.

President Roddy served as master of ceremonies at the dinner held in Walker Memorial on September 6, at which Dean Harrison was the after-dinner speaker. Dr. Harrison spoke in a light and amusing vein on "Around the World in 27 Years with the M.I.T. Alumni Association." Although Dean Harrison's talk consisted largely of a series of anecdotes drawn from his contacts over the years with M.I.T. students, Faculty, and Alumni, it concluded with a tribute to the late Karl T. Compton and a coda of appreciation for the warm and loyal support of Alumni. Indeed, all of the members of the Faculty and Administration who spoke at the conference stressed the importance of alumni support, but none more eloquently than Dr. Killian who said:

"We at M.I.T. are grateful for your presence here and for the loyal and helpful impulse which brings you to these biennial meetings. I speak for the Institute community – Faculty, Administration, students – in thanking you for what you individually and collectively are doing for M.I.T. and in acknowledging the many ways which Alumni assist the Institute and further its mission."

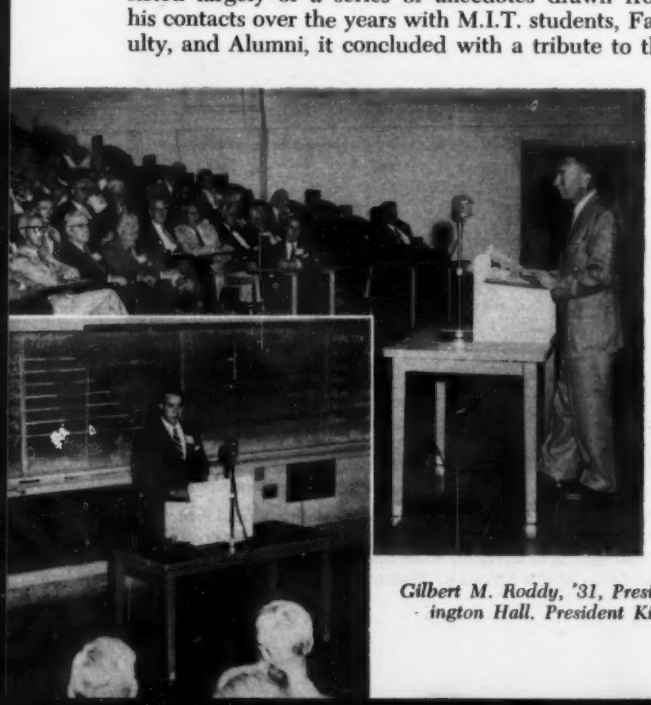
The conference formally opened at 10:00 A.M. on Friday morning with a two-hour session in Kresge Auditorium on the general subject of "Educational Progress at M.I.T." William L. Taggart, Jr., '27, chairman of the Conference Committee, presided, and the speakers were J. A. Stratton, '23, Chancellor, who discussed the general princip'es governing the dynamic and evolving educational policies of the Institute; H. Guyford Stever, Associate Dean of the School of Engineering, who reviewed recent developments in engineering education at M.I.T.; and John T. Rule, '21, Dean of Students, who spoke on the role of nonacademic factors in a modern educational program.

### Educational Progress at M.I.T.

In his opening remarks, Dr. Stratton sketched in brief the total M.I.T. educational picture and outlined a number of academic developments and operating policies which other speakers later elaborated upon in some detail in later sessions of the two-day meeting. He placed major emphasis in his discussion on evolving changes in organizational structure and administrative philosophy at M.I.T. and on the current plan of undergraduate education in areas relating to our technological way of life.

Early in his remarks, Dr. Stratton emphasized that M.I.T. is, first of all, an institution for undergraduate education. One of the great problems currently besetting undergraduate educational policy, he pointed out, is the need to maintain intellectual quality in the face of growing demands and pressures for more engineers. But if M.I.T. is to maintain its high educational standards. Dr. Stratton reported, the Administration believes that the Institute cannot grow much in numbers at the present time. For the undergraduate program this means stabilization near the present total enrollment of about 3,600. In a program of stabilized undergraduate enrollment the Institute cannot admit all who wish to enter as freshmen, but it can absorb more upperclass transfer students than now apply.

Dr. Stratton next reviewed the factors in our technological age that have accounted for an increase in the time required to achieve competence in professional work and which have stimulated the vigorous growth of the M.I.T. Graduate School. It now takes many more years of study to become proficient in a technical profession than in the past. In science careers, a doctorate is now practically indispensable.



*Gilbert M. Roddy, '31, President of the Alumni Association, addresses Alumni officers in Huntington Hall. President Killian* (lower left-hand insert) *later addresses the same gathering.*

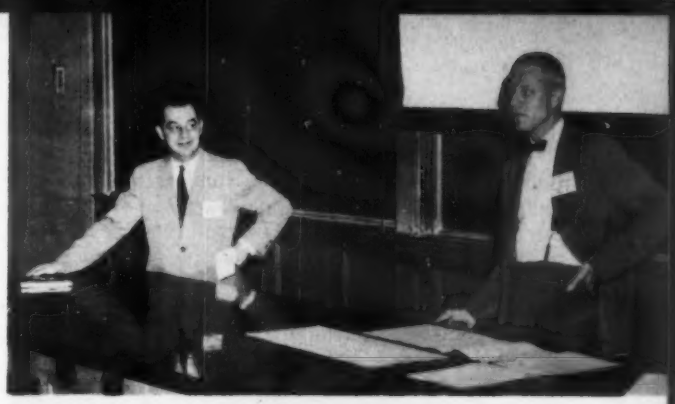
At M.I.T. there has also been in the last decade a marked increase in doctoral work in engineering and in post-doctoral work in science.

The Institute's Graduate School enrollment consequently has grown to about 2,500, or a little more than 40 per cent of our total enrollment. As with the undergraduate school, it is clear, Dr. Stratton said, that M.I.T. faces a problem of limiting the growth of the Graduate School.

In summarizing his discussion of M.I.T. enrollment problems, Chancellor Stratton emphasized again that the Institute has a greater national responsibility to maintain the high quality of the M.I.T. educational program and the high competence and character of the men it produces than merely to train large numbers of students. From this point of view, he concluded, an analysis based on considerations of space, facilities, financial resources, and instructional quality suggests an optimum enrollment figure for M.I.T. of between 6,000 and 6,500 students at all levels.

In discussing the organization of academic administration at the Institute, Dr. Stratton noted first of all the continuing trend toward decentralization. This trend has been necessitated, in part, by the sheer magnitude and range of activities which characterize today's M.I.T. The Institute can achieve its educational objectives only by giving a real degree of freedom and autonomy to each school. In a top-notch institution, he added, there must be also a certain degree of autonomy in the various departments, and a consequent flexibility of curriculum. Of course this autonomy could go too far, but strength is gained, he said, from a unity of objective and a flexibility of approach.

Dr. Stratton then went on to analyze some of the specific aims and current problems of undergraduate education. Because of the changing status of the bachelor's degree, he said, we must alter our traditional concepts of the objectives of undergraduate education. We must accept the fact that a rising percentage of those whose interests are principally technical must go on to graduate school. As a consequence, we must also realize that undergraduate education can no longer be largely vocationally oriented nor developed only along purely technical lines. In general, Dr. Stratton concluded, we are coming to accept the concept that the function of undergraduate education is to provide a foundation for professional life centered on science and its applications.



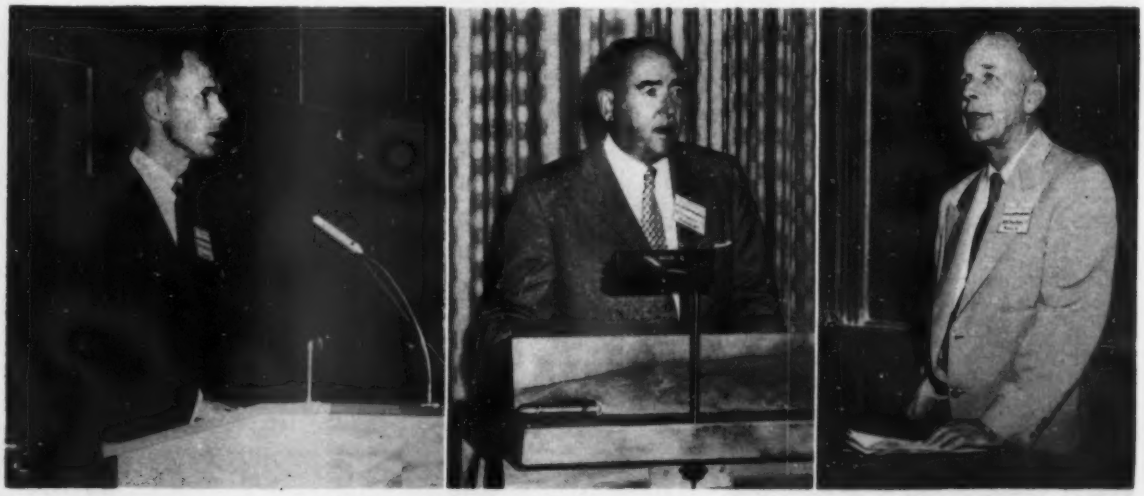
*Thomas P. Pitré, Associate Dean of Students (left), and J. Samuel Jones, Assistant to the Director of Student Aid, conduct a workshop session on student scholarships.*

Finally, Chancellor Stratton sketched the pattern of M.I.T. education as a fabric of four interwoven strands:

1. The first strand is spun out of the basic sciences of chemistry, physics, and mathematic. Physics and mathematics especially, he noted, are playing an increasingly important role in the third and fourth year curricula of many courses. He emphasized that it is difficult to deal creatively with many new fields without a thorough grounding in the basic sciences and added that the substance of many courses is changing much faster in this direction than mere catalogue names and numbers might indicate.

2. The second strand is composed of the humanities and social sciences. These studies have become an integral part of the education of the engineer and scientist who must have a clear comprehension of the social, intellectual, and historical context in which science operates. Without such a background, the scientist and engineer often can neither fully dis-

*D. Reid Weedon, Jr., '41, Vice-president of the Alumni Association* (left), *Whitworth Ferguson, '22* (center), *and Avery H. Stanton, '25, who are members of the Alumni Fund Board, take part in workshop sessions*



charge his responsibilities nor completely measure up to his opportunities.

3. The third strand is the professional component, which is becoming ever more fundamental in character. This is the area of applied science (electronics and thermodynamics would be good examples) which is filling an increasingly important place between science and engineering.

4. Finally, there are the nonacademic factors which contribute so importantly to the development of each student's character and the growth of his personality. This strand is composed in no small measure of the out-of-class contacts each student has with members of the Faculty and with other students; it is the sum of experience derived from student community living and from varied activities generally classified as "campus life." It is an area, the Chancellor concluded, to which the Institute is currently devoting more of its time and concern than ever before.

Following this opening talk, Deans Stever and Rule each elaborated upon some of the points to which Dr. Stratton had alluded in his Chancellor's-eye view of the academic program.

### Engineering Education

In discussing "Progress in Engineering Education at M.I.T.," Dean Stever began with a brief analysis of the current supply and demand for engineering graduates. He noted that, through the efforts of many organizations and individuals, the shortage of engineering graduates is not now as acute as it has been in recent years. There has been a gratifying increase in the number of graduates in the United States with more than 26,000 awarded degrees last year. But it is difficult to predict how the balance between supply and demand will shift in the near future. "Despite this uncertainty," Dean Stever added, "we are confident that there will continue to be a healthy demand for the quality product which comes from M.I.T.'s School of Engineering."

Against this general background Dr. Stever went on to discuss statistics which indicate M.I.T.'s position in engineering education. He said:

"At M.I.T., the enrollment in engineering was about 3,700 students during the year 1956-1957. This represented 61.5 per cent of the Institute's student population. Of these 3,700 students, about 1,350, or 37 per cent, were graduate students. When compared with figures from previous years, a continued shift to graduate education in engineering at M.I.T. is clearly indicated.

"Looking at numerical data from the rest of the country one sees that M.I.T.'s numerical contribution to engineering education in the country now falls primarily in the graduate field." In the years from 1950 to 1956, 12.6 per cent of all the doctor's degrees in engineering in the United States were given by M.I.T. In 1956 the number was slightly higher, 13.8 per cent. Of course the percentage differed from department to department. The Metallurgy Department produces about 30 per cent of the doctor's degrees in its field in the country; the Aeronautical Engineering, Chemical Engineering, Electrical Engineering, and Mechanical Engineering Departments vary in percentages from 10.3 to 14.3 per cent, and the Civil and Sanitary Engineering Department awards 5 per cent of the doctor's degrees in its field. M.I.T. also holds a corresponding commanding posi-

*Buffet supper in Walker Memorial has all the trimmings to delight the eye and tongue, including upright beaver carved from block of ice. Head table guests at buffet dinner were* (left to right in lower insert): *Donald P. Severance, '38, Henry B. Kane, '24, Robert M. Kimball, '33, William L. Taggart, Jr., '27, Joseph J. Snyder, '44, Gilbert M. Roddy, '31, George R. Harrison, J. A. Stratton, '23, Dwight C. Arnold, '27, Vincent T. Estabrook, '36, B. Dudley, '35, and Joseph E. Conrad.*

tion in awarding the master's and the engineer's degrees. Relatively, M.I.T.'s contribution in the undergraduate field is only about one-fifth of its graduate contribution. "Of course," he emphasized, "the statistics concerning the numerical ratings of schools do not take into account quality."

In discussing undergraduate education in engineering, Dr. Stever first noted that the increasing demands on the student's time for the basic sciences, engineering sciences, humanities and social studies, as well as the participation in extracurricular affairs, must naturally crowd something out of the undergraduate years of education.

"Though both students and Faculty are more efficient in using their time, the increasing efficiency has not been able to keep up with the increasing demands on time. Time must be taken consequently from the professional engineering subjects.

"At present neither the study nor the debate on this topic has been concluded," he emphasized. "Individual Faculty members and engineering departments place differing emphases on different facets of engineering education. The engineering departments are now introducing changes in their curricula in an attempt to improve the undergraduate course. The fact that the changes are quite different from department to department," he felt, "insures a healthy vigorous attack on the problems. In addition, differences are to be expected, for the individual engineering departments serve industries and professional communities which differ markedly in their natures."

Dr. Stever concluded his remarks by giving some examples of the interesting trends in engineering education which have been put into effect over the last few years at M.I.T.

In the Department of Electrical Engineering, he reported, for example, a new curriculum (called Electrical Science and Engineering) has been under development. The work in this option includes more higher mathematics and physics than the normal Electrical Engineering courses and the Electrical Engineering Co-operative Course by the extent to which it emphasizes the electrical science aspects of the core curriculum subjects. Course is normally of five years' duration with the degree of bachelor of science and master of science awarded simultaneously.

The Department of Chemical Engineering, he cited as another example, has introduced a significant change in the policy of its undergraduate program which has also received Faculty approval and will begin to operate this fall. Here the primary purpose is to increase the choice of subjects available to the students by replacing many specified requirements with electives in the upper years of the undergraduate course. It is hoped the new approach will place greater responsibility on the student for planning his future, and will allow him more flexibility in preparing for graduate specialization in a variety of fields, such as chemical engineering, nuclear engineering, or the biological sciences.

*Association President Gilbert M. Roddy, '31, makes presentation of bronze beaver awards to individual Alumni, Alumni clubs, and Alumni groups.* (At top): *Bryant Nichols, '07, is receiving award for work in connection with the 50th reunion of his class. Center panel shows Mr. Roddy making awards to Stuart G. Stearns, '39, and Donald H. Spitzli, '27, for a study (made by the M.I.T. Club of Northern New Jersey) of the factors affecting the growth and influence of an M.I.T. Club.* (Bottom): *Frederick J. Kolb, Jr., '38, receives award from Mr. Roddy on behalf of the Alumni of Rochester, N.Y., who established an outstanding record of participation in the 1957 Alumni Fund.*

**The Student of Today**

Following Dr. Stever's remarks, Dean Rule discussed some of the nonacademic factors important to the total educational process. He developed his discussion around the observation that academic progress is often highly colored by personal factors. He also noted as a general proposition the inescapable obligation of an educational institution to assume its proper share of responsibility for the character development of its students.

"As we have become increasingly aware of the social responsibility of the engineer and the scientist in our modern American life," Dean Rule said, "we at M.I.T. have more and more tended toward the concept that it is our responsibility to develop the breadth and the character of our students as well as to see that they have adequate academic training. Indeed, it is quite clear that if a student is completely ruthless, acquisitive, and enamored only of personal power and gain, a first-rate academic education makes him more of a menace than an asset to our society."

He continued with a brief "personality portrait" of today's student as seen from inside the Dean's door. "In anything I say," Dean Rule cautioned, "I do not

*Faculty members who participated in the addresses in the lecture hall of the Compton Laboratories on Saturday, September 7, were* (left to right): *Jay W. Forrester, '45, who spoke on systems technology and management; Charles S. Draper, '26, who reported on research on inertial guidance; George R. Harrison, who demonstrated a 10-inch diffraction grating recently ruled at M.I.T.; and Nathaniel H. Frank, '23, who told about recent changes in the physics curriculum.*

want to imply that our students, or at least a great majority of them, are not intellectually curious, are not starry-eyed about science, and do not hope to become Einsteins or to make the definitive discovery in whatever field they may choose. Certainly most of them as entering freshmen have these dreams. Some of their other basic outlooks, however, have changed quite radically over the prewar period, and these changes are a large factor in some of our problems." The changes to which Dean Rule referred are by no means unique to M.I.T. students. They are, in fact, characteristic of those young persons who were born during the depression, attended grammar school during World War II, and who reach maturity in our present era of inflation. To a greater extent than ever before, these young people are influenced by dwindling parental and school authority, by loosened church ties, by dependence on external forces (rather than internal resources), such as motion pictures, radio, and television, and by the greater mobility which the automobile makes possible.

Dean Rule noted particularly the following points: First, young people today tend to seek "certainty of future, rather than brilliance of future." He reminded his audience that today's freshman was a "Pearl Harbor baby" whose impressionable years were spent in a very insecure world. Such students focus attention on the kind of job they are going to get on graduation and on how much money it will pay rather than on the service they can perform as professional men. One serious result is that this type of student is insulated, to a degree, from the effects the Humanities program is intended to provide.

Many a student, Dean Rule continued, has a marketing mind. Such a student tends to see education chiefly as a purchasable commodity. When he pays tuition he expects delivery of knowledge or access to lucrative positions. His attitude toward the rules and regulations of the Institute and toward the academic program is that of buyer-to-seller, in a contractual situation which tends to de-emphasize individual initiative and responsibility.

Dean Rule also commented on the fact that M.I.T. now has many more married students than was usual prior to World War II. He emphasized that today even a sizable number of undergraduates are married before they take their degrees. This increase in the number of married students, Dean Rule added, contributes toward the focus on the practical and on the immediate phases of life.

"All of these observations concerning today's students," Professor Rule concluded, "can be summed up by saying that the state of mind of young men in America today is quite different from what it was before the war, that around the solid core of students whom we get who have intellectual curiosity and enthusiasm to learn and the genuine desire to be worthwhile, are grouped a number of peripheral tendencies which give us a larger number of less desirable traits in our students than I think we used to have. The increasing number of students with what we consider poor attitudes makes it of great importance that we discharge to the utmost of our ability our responsibilities to develop that side of education which can improve these attitudes, and this can be done chiefly outside the classroom.

"To describe the things we do about this, I shall divide the problem into two parts. First, I want to look at the things we do to free the student to do better academic work. That is, the things we do to help him with his emotional problems, his worries about money, his sense of insecurity, and all of those things which directly affect his ability to work well and to learn well. This whole area, for simplification, I will designate as a counseling area.

"I want to say at once that we are all of us opposed to 'holding a student's hand,' to 'spoon-feeding him,' to being oversympathetic. We believe that a student should stand on his own two feet and that he should be held responsible for his actions and for his academic record. This does not bar our giving him every aid to achievement.

"We know very little about the learning process, but anyone who has followed recent efforts in the psychology of learning, studies in the interrelations between emotions and learning, between motivation and learning, cannot fail to be deeply impressed by the improvement in academic performance achieved by skillful and professional efforts in the counseling area. When we accept students into the Institute who have the intellectual capacity to do Institute work, we are much more efficient if we remove their blocks to learning and help them to achieve their full poten-

*(Continued on page 50)*

# BUSINESS IN MOTION

## *To our Colleagues in American Business . . .*

Should a fire break out in many of the modern stores, office buildings and institutions today, the excited cries of "Fire!" "Fire!" "Fire!" will have barely died before the fire is under control. For, located in the ceiling of these structures, and barely visible, are the automatic sprinklers that go into action in case of fire. And mighty important fire watchers they are, too. Although unnoticed and unattended for years, they must be able to go into immediate action, fast, and without fail.

A vital part of this sprinkler is the body. A leading manufacturer of these sprinklers used to make these bodies of cast bronze. But in order to obtain the close tolerances required, the casting had to be excessively machined. Also, in order to assure fool-proof operation after installation, each casting, after machining and prior to assembly, had to be pressure tested. Due to porosity many of the castings failed and the number of rejects became prohibitive.

Engineers of the sprinkler manufacturer consulted with Revere's Technical Advisory Service and as a result Revere was asked to forge the sprinkler body. After extensive testing, the forging of Revere Brass was selected . . . because it was found that closer tolerances with a minimum of machining were possible, elimination of sand holes did away with rejects entirely, pressure testing was no longer necessary and the better appearance of the forging made a more sales-appealing product. On top of this the rate of assembly was nearly doubled by the use of Revere Brass Forgings. Overall savings amounted to more than 20% of the former cost of the sprinkler body.

Here you have still another example of Revere cooperating with the customer in selecting the right metal in the right form to do the best job with the greatest economy . . . be it aluminum, copper or any one of their alloys.

Not only the copper and brass industry but practically every industry you can name is able to cite similar instances. So we suggest that no matter what your suppliers ship you, it would be a good idea to take them into your confidence and see if you cannot make a better product at lower costs by specifying exactly the right materials.

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*Founded by Paul Revere in 1801*

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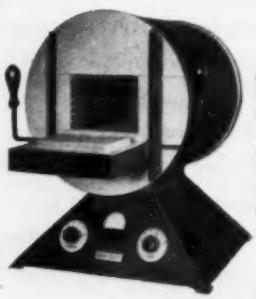
COMBUSTION TUBE FURNACE — Hinged tube furnaces are available in various sizes with temperature ranges to 1800°F or 2200°F.



MUFFLE FURNACE—"Multiple-Unit" Muffle furnaces have a maximum temperature of 1850°F. Temperature indicating and controlling devices are located in the pyramid base for full protection and visibility.

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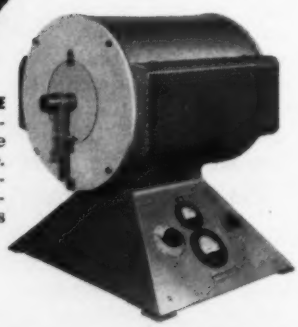

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Harold E. Koch, '22, *President*
Elton E. Staples, '26, *Vice President*
Chester Meyer, '36, *Assistant Secretary*

## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 48)*

tiality through understanding and skillful direction than we would be were we to allow every individual to stand or fall on what he produces in the classroom only, without helping him when we know he has the ability."

Dean Rule then outlined in brief detail some of the elements of the M.I.T. counseling system. He noted we now have a Dean for Counseling, Dean William Speer, "who knows full well that the secret of good advising is never to advise, but to listen and illuminate and discuss the consequences of possible actions." He stressed also the successes of the Freshman Advisory Council, which consists of some 70 staff members who are advisers to 15 freshman students each. In addition Dean Rule reported, the Medical Department's psychiatrists, whom he called skilled "psychiatrists of the normal" are helpful in shifting attitudes within students which are detrimental to their progress. Finally, he paid tribute to the athletic coaches who, he said, have great insight into young men, who understand them and can help them with their problems.

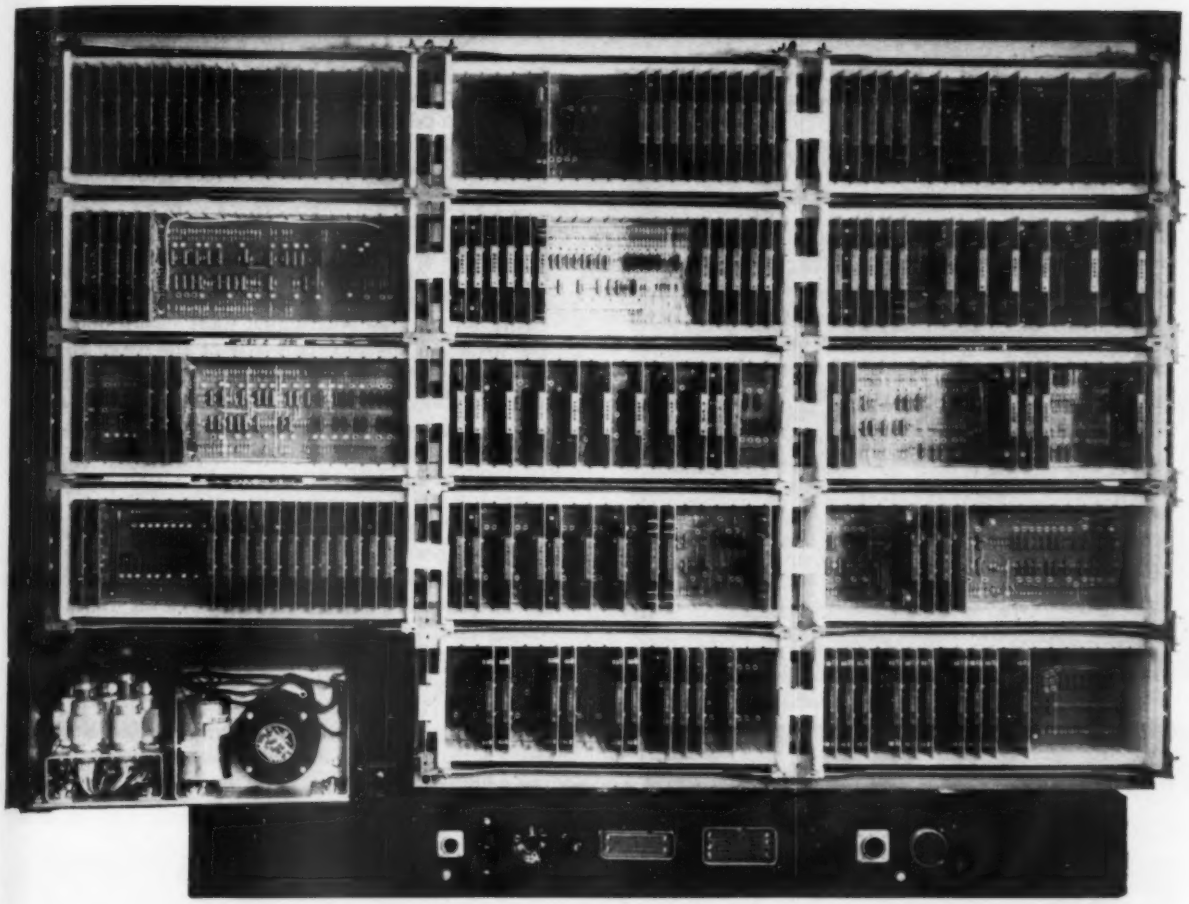
Following his discussion of the Institute's counseling responsibilities, Professor Rule turned to what he termed "the most important element in the whole picture" – the philosophy that a residential college is an educational structure in all of its parts. To simplify his argument, he discussed this philosophy in terms of dormitories.

"One of the central facts of college life," Dean Rule emphasized, "is that it coincides time-wise with the normal period in a young man's life when he revolts from his family and becomes himself. In fact, for many university students the central problem of their life is the problem of finding out who they are as opposed to who their parents are, and of escaping from their parents into themselves. Thus it is a period of breaking old habits and old outlooks and of forming new ones.

"Very, very much of the acquiring of new outlooks occurs in a very short time when the student first arrives at the university. But it does take some time to gel, and consequently we are afforded an opportunity to structure it along constructive lines. Thus the atmosphere in a dormitory, the way it is conducted, its physical structure, the kind of government it has, the conversations that occur in it, the attitudes of the students in it, are of crucial importance to young students – particularly in the first month or so of their living there. If we subscribe to the thesis that everything that occurs to a student in a university is part of his education, then a dormitory is very rich indeed in opportunities to help educate the students living in it.

"Ideally a dormitory should have a rich tradition of outlooks and practices which are passed on from year to year by mature individuals with longer tenure than the undergraduate student. Students in a dormitory should have high morale and loyalty to the house, established by traditions of a high order in a stimulating intellectual and cultural existence. Life in a dormitory should be well mannered; opportunities

*(Continued on page 52)*



## The Role of
# PRODUCT ENGINEERING
## in Systems Work

It has become characteristic of modern weapons systems that they are required to operate under severe environmental conditions, as well as to meet stringent weight and space limitations. Moreover, the complexity of many of these systems poses additional difficult reliability problems, while at the same time the increasingly critical consequences that depend on the proper functioning of the typical system logically call for a *higher* degree of reliability than previously achieved. The same is true of certain electronic systems for industrial applications, such as the Ramo-Wooldridge digital control computer, some of whose design features are shown above.

Meeting all of these requirements is in large part the responsibility of product engineering. Generally speaking, product engineering starts with a system or subsystem at the breadboard stage and transforms it into the final product, which in addition to meeting all of the requirements previously stated, must be practical to manufacture and to maintain. Such creative productizing requires the development of ingenious mechanical design features, a thorough knowledge of circuit design and component reliability, and a broad familiarity with materials and manufacturing processes.

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## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 50)*

for good conversation with Faculty, foreign students, and interesting and stimulating Alumni should be at a maximum."

Professor Rule then related the report of the Ryer Committee (Technology Review, June, 1956, page 413; July, 1956, page 486) to this discussion.

"The Ryer Committee found in studying dormitory systems in other universities," Dean Rule recalled, "that the ideal loyalty group – the one which is most easily governable and which most easily commands the loyalty of its members – is of the order of 50 or 60, very nearly the size of most of our fraternities. Ideally, then, the best dormitory should be of the order of 200 students divided into four groups, say over four floors. Such groups should be a vertical assemblage of students, that is, they should be graduate students, seniors, juniors, sophomores, and freshmen. And the whole house should be led by a mature staff member who is constantly striving to develop all of the educational possibilities of his house. We are working toward this concept. The Ryer Report recommended breaking the dormitory system down to these smaller areas and supplying dining rooms for each area where sit-down, family-style meals could occur.

"Although we have not gone very far along the path I am outlining," Dean Rule concluded, "we are

*(Continued on page 54)*

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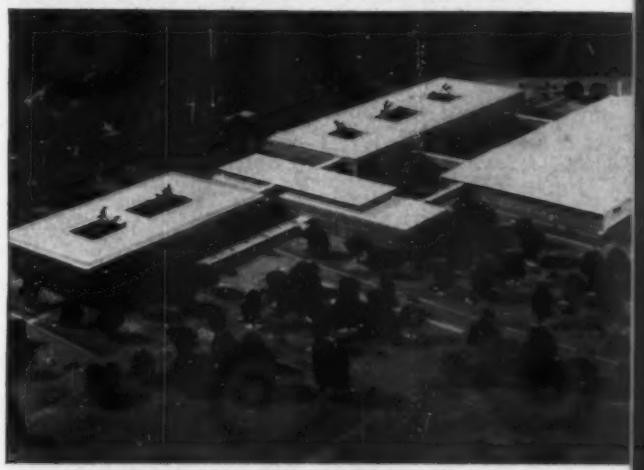
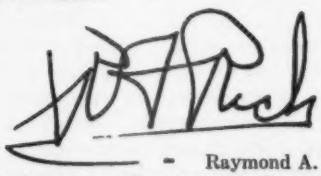


Pictured above is our new Research and Development Center now under construction in Wilmington, Massachusetts. Scheduled for completion in early 1958, this ultramodern laboratory will house the scientific and technical staff of the Avco Research and Advanced Development Division.



– Raymond A. Rich
President, Avco Manufacturing Corporation

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## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 52)*

well aware of the possibilities involved. We hope to work through to a dormitory system of which the students will be wholeheartedly proud, which they will find stimulating and broadening, in which they will feel they are members of a community of scholars which has unity and loyalty toward mature ideals and goals."

Following Dean Rule's remarks, which completed the Friday morning session on "Educational Progress at M.I.T.," the Alumni adjourned to the Campus Room of the Graduate House for lunch. Then, promptly at 2:15 P.M., the afternoon session convened within the familiar walls of Huntington Hall (Room 10-250) where major addresses on "The Challenge of the Future" were given by Association President Roddy and by Institute President Killian.

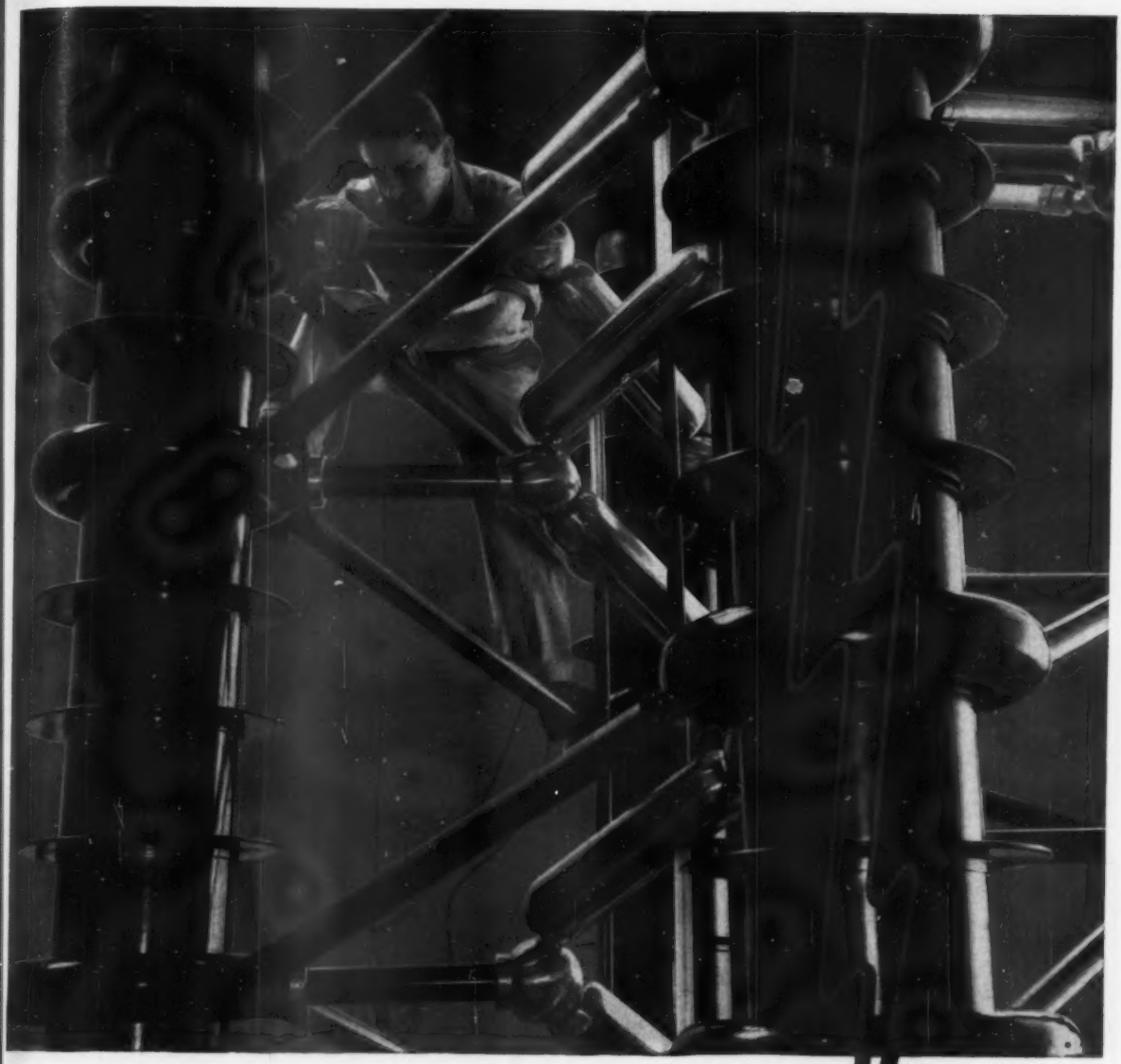
### Challenge of the Future

Dr. Killian gave an inspired address. Although touching on many topics, his talk stressed two specific points of great current concern in which the Institute needs Alumni help. The first point discussed the need for Alumni to help many outside the Institute to gain a better understanding of the broad resources of M.I.T. and to see more clearly the aims and objectives of its educational program.

"The image of M.I.T. in the minds of many people," Dr. Killian said, "is quite out of date. Too many people still think of M.I.T. as being narrow and highly specialized in its education and illiberal in its outlook. Some even think of the Institute in terms of a vocational school or a technical institute. It is important to correct this image for many reasons, not the least of which is the adverse effect it has on the kinds of students who apply for admission to the Institute. We want to broaden the range of types who apply for entrance here. High intellectual competence must be common to all of these types. We want students who can become successful leaders of men as well as those who will be brilliant specialized research scholars. The two are, of course, not mutually exclusive. We want students of outstanding personal qualifications as well as outstanding intellectual capacity. As Professor Thresher comments in his recent report to the President, 'The reputation of the Institute must rest upon the social effectiveness of the graduates and the broad objectives of our selection are to maximize the number of Alumni who will make an impress on the life of their times.'

"It is important to recognize, too," Dr. Killian added, "that no single type is best for the wide range of educational programs at the Institute. Civil Engineering, as our Visiting Committee in this field recently emphasized, may well need students of different qualifications than the more mathematically inclined student who is desirable in physics. We educate architects, economists, managers, as well as engineers and scientists. M.I.T. students go into many different professions after completing their undergraduate careers here, and we like to think of our un-

*(Continued on page 56)*



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## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 54)*

dergraduate program as having the breadth and the opportunity to prepare men to be effective citizens in a wide range of career activities. . . ."

"The second area in which we need Alumni help," Dr. Killian continued, "is in the effort M.I.T. will be making this fall to complete a fund for raising Faculty salaries at the Institute. The Alumni Fund Board will make the improvement of Faculty salaries one of its main objectives for 1957-1958. To supplement the Fund Board effort, a more intensive drive will also be made to meet the goal through a special gifts program." Dr. Killian also emphasized that all Alumni can help in furthering general understanding of the need for the fund and in telling the M.I.T. story to potential friends of the Institute.

"Inadequate salaries for teachers is, of course," Dr. Killian said, "not a deficiency confined to M.I.T. The recent report of the President's Committee on Education Beyond the High School, released on August 11, gives major emphasis to the 'need for qualified teachers' as the critical problem facing colleges today. In its analysis of the financial problems which the nation faces in financing higher education, the report gives top priority to the provision of adequate salaries to retain and compensate present staff adequately, and to attract additional needed numbers of high-ability teachers. It suggests as a broad goal gradual increase of salaries 'no less than double the present average level on an over-all national basis in five to ten years.' The urgency to increase salaries is indeed acute, particularly for our institutions holding positions of leadership.

"M.I.T. is much better off," Dr. Killian added, "than many institutions in the competition for scholars among institutions, its salaries being substantially better than average among the colleges. But its real competition is with industry and professional careers outside of education. Many young men graduating from the Institute with advanced degrees now obtain positions at the start of their careers paying higher salaries than their experienced teachers receive. The discrepancy between industrial and academic salaries is greater in the fields of engineering and science than almost any other, and this gap threatens to divert too

*(Continued on page 58)*

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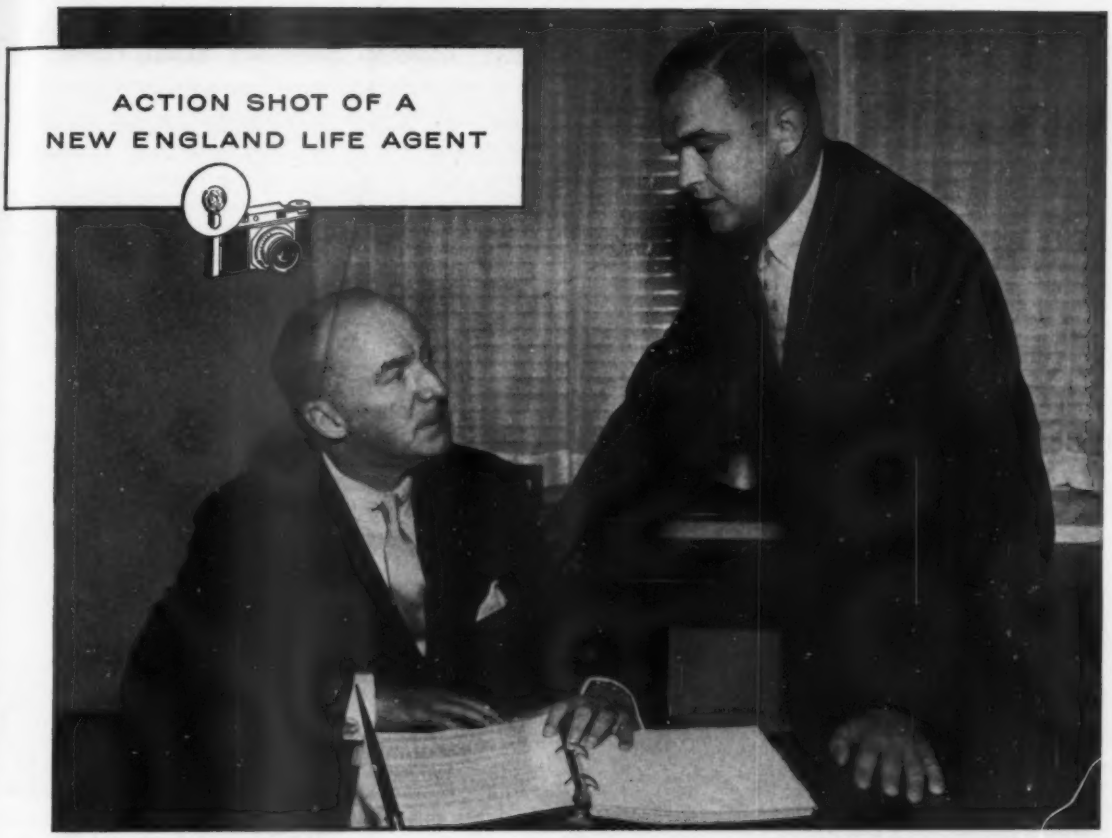


# Jack Langan discusses additions to Inter-County's pension plan

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Inter-County is a large organization with offices throughout the nation and Jack worked hard to tailor the plan exactly to their specific requirements. President Thomas H. Quinn (seated at desk in picture above) has been most appreciative. And he is enthusiastic not only about the plan itself, but about the professional assistance Jack continues to offer in servicing it.

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## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 56)*

many able young engineers and scientists from electing academic careers when they might otherwise be interested. If talented young people are to be attracted into academic careers, such conditions must be remedied. The quality of our institution during the decades ahead can be seriously diminished unless we succeed now in making academic careers more attractive.

### Significant Step

"As I announced on Alumni Day, M.I.T. now has a chance to make a significant step ahead in its Faculty compensation. Alfred P. Sloan, Jr., '95, through the Alfred P. Sloan Foundation, Inc., has offered to make a grant to M.I.T. of up to $1,250,000 toward a $5,000,000 fund for Faculty salaries, provided the Institute obtains $3,750,000 from other sources. The Corporation has accepted the challenge of this timely offer of Mr. Sloan's, and in the past few months we have quietly secured in gifts and pledges more than a million dollars toward the three and three-quarter million dollars that we must raise. With this encouraging start, we now undertake a special and concentrated drive to secure the remaining two and three-quarter million dollars which will insure the full amount from the Sloan Foundation and thus will enable the Institute to meet the total goal of a five-million-dollar Faculty Salary Adjustment Fund.

"We are now getting organized to complete this special gifts program. A strong committee, under the chairmanship of Walter Beadle of the Class of 1917 and a life member of the Corporation, is leading the final effort. Associated with Mr. Beadle on this committee as regional vice-chairmen will be the following Alumni: Oliver L. Bardes, '21, of Cincinnati; Charles A. Chayne, '19, of Detroit; Francis J. Chesterman, '05, of Philadelphia; Cecil H. Green, '23, of Dallas; Robert C. Gunness, '34, of Chicago; Homer V. Howes, '20, of St. Louis; H. W. McCurdy, '22, of Seattle; Antonio H. Rodriquez, '21, of Havana; William C. Sessions, '26, of Cleveland; David A. Shepard, '26, of New York; William J. Sherry, '21, of Tulsa; Raymond Stevens, '17, of Cambridge; William L. Stewart, Jr., '23, of Los Angeles; and Irving W. Wilson, '11, of Pittsburgh. Many other Alumni are also assisting in the drive.

"It is our hope and ambition," Dr. Killian concluded, "that once the urgent need for this Faculty Salary Adjustment Fund is clearly understood, our goal will be readily reached."

### Alumni-Institute Relations

Dr. Killian had been introduced by Association President Roddy who had spoken earlier on the character and quality of the relationship between the Alumni Association and the Institute.

Mr. Roddy began his remarks by discussing the structure of the Alumni Association, by noting that there are about 48,000 living M.I.T. Alumni eligible

*(Continued on page 60)*

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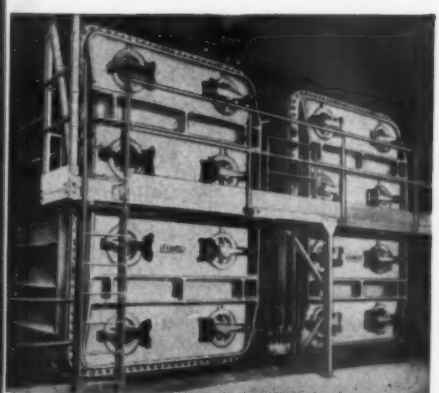

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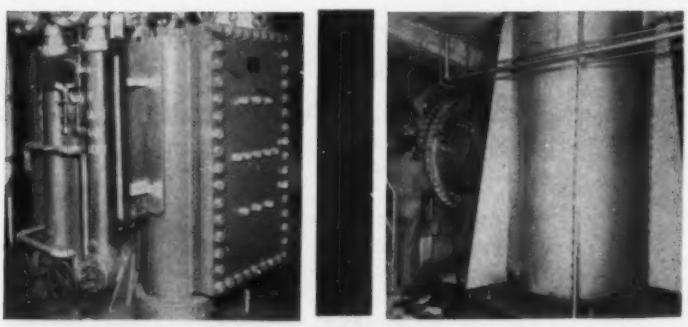

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## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 58)*

for membership in the Alumni Association, and added:

"For many of our Alumni the Institute has become a lifetime activity. About half the Faculty and staff of the Institute have M.I.T. degrees. About 60 per cent of the Departmental Visiting Committee members are Alumni. The Educational Council is composed entirely of Alumni and still others are members of the M.I.T. Corporation. Moreover, about half of all active Alumni have contributed to the Alumni Fund at some time. But M.I.T., as one of the top half dozen most influential educational institutions in the country, deserves the active and continuing support of all Alumni."

Mr. Roddy then outlined the objectives of the Alumni Association for the 1957-1958 year as follows:

1. A more productive Alumni Fund.
2. Plans to make greater contributions to the effectiveness of student life at the Institute.
3. Sponsorship of three Regional Conferences – one in Pittsburgh on Saturday, December 7, 1957; one in Washington, D. C., on Saturday, March 1, 1958; and a third in the spring at a city yet to be named.
4. Co-operation with the M.I.T. Administration in planning for the Institute's centennial celebration in 1961.
5. Improved communication between the Associa-

*(Continued on page 62)*


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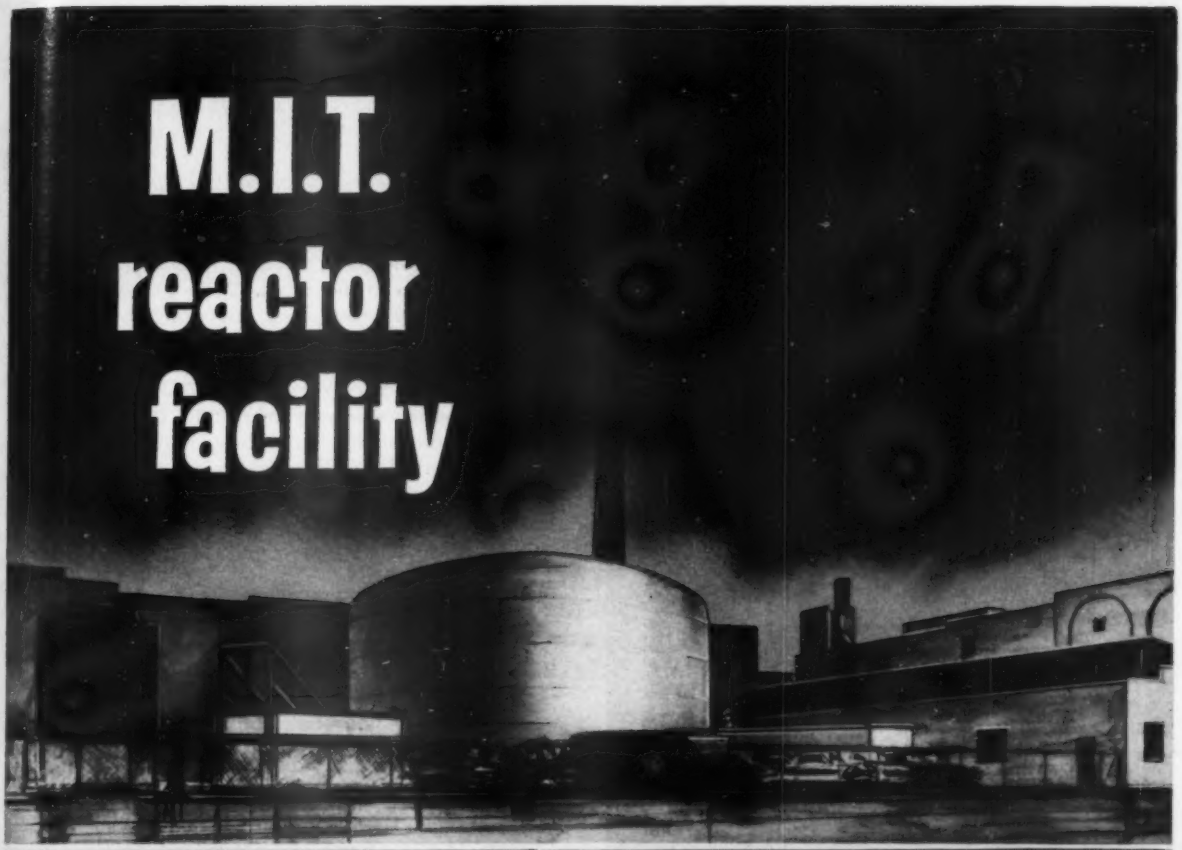

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- 20,000 kw light water materials testing and research reactor for Reactor Centrum Nederland.
- 30,000 kw light water materials testing and research reactor for Aktiebolaget Atomenergi of Sweden.
- 10,000 kw light water materials testing reactor for the Nuclear Engineering Test Facility, Wright-Patterson Air Force Base, Ohio.

*Engineers and scientists interested in joining this large, well-staffed and well-backed group are invited to inquire into the many available opportunities.*

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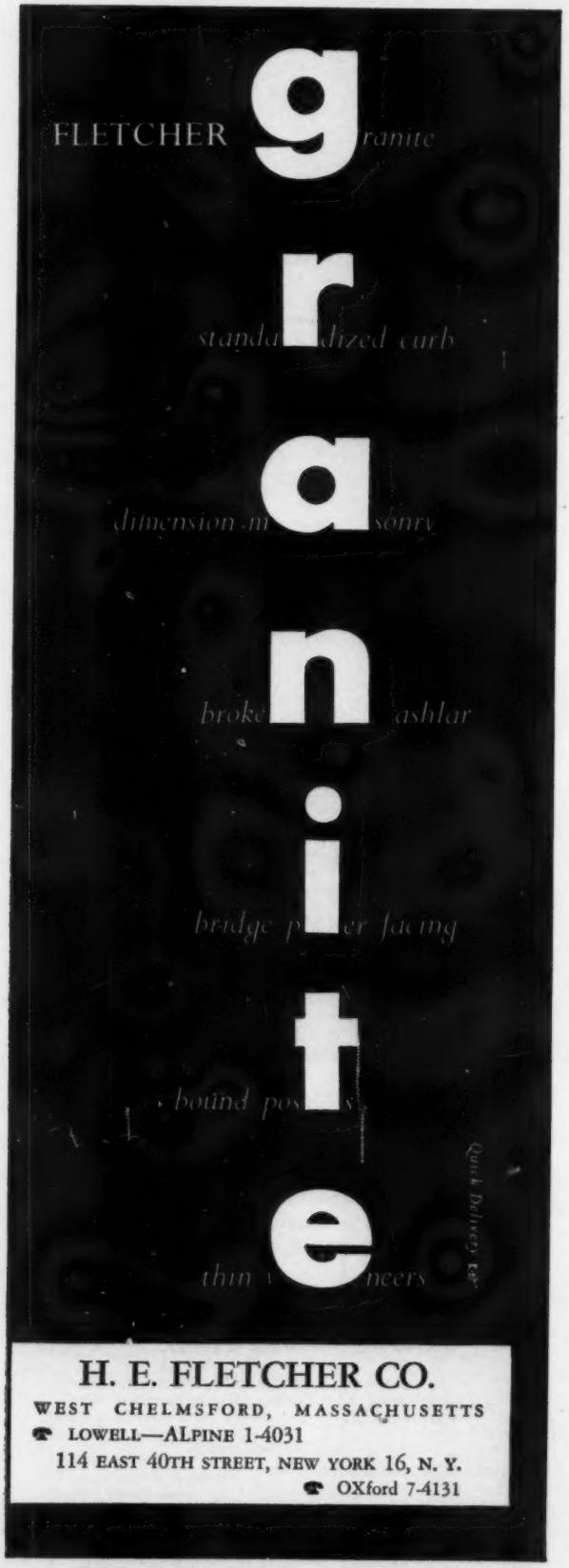



## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 60)*

tion and the Institute, its Alumni, and other persons.

Mr. Roddy then discussed the first two objectives in brief detail.

Mr. Roddy also reminded his audience that over the past two years the Association has instituted a Regional Solicitation plan, in which personal contacts are made at the local level, to increase the number of contributors to the Fund. Although the emphasis in regional solicitation is on increasing the degree of participation, Mr. Roddy said he "could see no objection to increasing the amount of the average contribution."

In discussing the need for Alumni to make greater contributions to the effectiveness of student life, Mr. Roddy referred to Dean Rule's remarks about the differences in attitudes between today's students and those who had attended M.I.T. prior to World War II. He suggested that Alumni can help the student body develop more sound and mature attitudes by taking an active interest in such aspects of student life as the graduate council, athletics, publications, and dormitory and fraternity social groups. After all, he concluded, it is in its educational mission that the Institute finds its highest purpose.

At the conclusion of the talks in Huntington Hall (Room 10-250), the general session adjourned for a series of panel meetings. Topics and chairmen included the following: *Regional Solicitation*, Avery H. Stanton, '25, Member, Alumni Fund Board; *Class Agents*, Alf K. Berle, '27, Member, Alumni Fund Board; *Class Special Gifts Solicitation*, Whitworth Ferguson, '22, Member, Alumni Fund Board; *Educational Council and Honorary Secretaries*, Thomas P. Pitré, Director, M.I.T. Student Aid; *Club Officers*, Donald P. Severance, '38, Secretary-Treasurer, Alumni Association.

### Research at M.I.T.

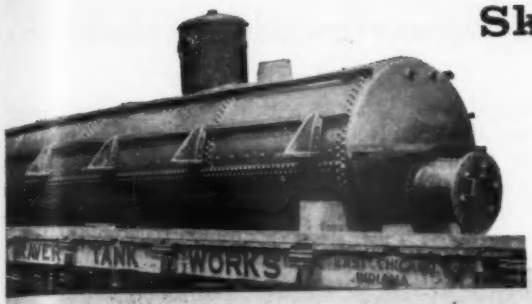
These panel meetings completed the business sessions of the Friday program. The social activities and award ceremony conducted on Friday evening have been reported earlier in this account. The Saturday morning meeting, at which D. Reid Weedon, Jr., '41, Vice-president of the Alumni Association, presided, was devoted to discussion and demonstrations of "Examples of Research at M.I.T."

Speakers at this session were: Jay W. Forrester, '45, Professor of Industrial Management, who discussed "Systems Technology and Management"; Charles S. Draper, '26, Professor of Aeronautical Engineering, Head of that Department, and Director, Instrumentation Laboratory, whose title was "Inertial Guidance"; George R. Harrison, Dean of the School of Science, speaking on "The New Precision"; and Nathaniel H. Frank, '23, Head of the Department of Physics, who spoke on "The Laboratory for Nuclear Science and the Research Laboratory of Electronics: Their Contribution to Education at M.I.T."

Dr. Forrester showed how data processing and other technological developments are related to the

*(Continued on page 64)*

# Skilled Then... in Quality Riveting As Today... in Quality Welding

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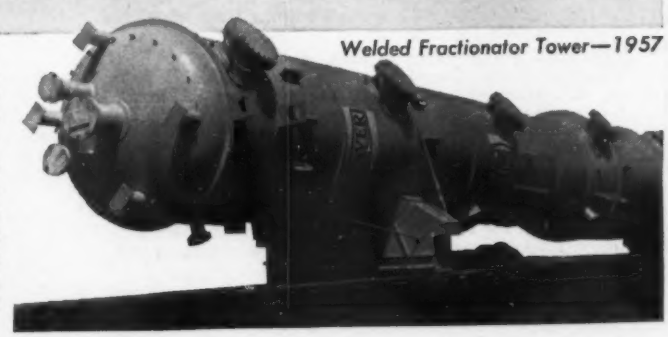
Some of the many types of riveted fabrication by Graver, as advertised in National Petroleum News, July, 1913

Joining plate with rivets for processing equipment, pressure vessels and storage tanks would be quite unsatisfactory today. Yet, before welding became an accepted fabricating technique, to which Graver contributed measurably in perfecting, Graver's boring and riveting methods were recognized as the most advanced in the country. Today, the most advanced welding, X-ray testing, stress-relieving and assembly methods are employed. This is what you can always expect from Graver—a pioneer in skilled steel and alloy fabrication for 100 years!



*Welded Fractionator Tower—1957*

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## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 62)*

industrial management program at M.I.T. He emphasized that the Institute's new I.B.M. 704 computer (see page 30, this issue of The Review) is an outstanding present-day tool for simulating certain industrial and economic model systems, and reported that the M.I.T. 704 will be employed in a large-scale attempt to use electronic computing techniques to understand and to aid the management decision-making process. He concluded his remarks with some provocative examples of how new management developments may in turn affect engineering education and practice. Professor Forrester's remarks complemented those given in his article on page 417 of the June, 1957, Review.

Next, Dr. Draper gave a brief demonstration-lecture on the principles of inertial guidance, the new jam-proof form of navigation for airplanes, missiles, and ships developed by the M.I.T. Instrumentation Laboratory. Some details of this gyro-controlled system, which promises to make it possible to pilot any craft to any spot on earth by using only inertial elements within the vehicle itself, were reported on page 488 of the July, 1957, issue of The Review.

Dean Harrison exhibited a 10-inch diffraction grating which had just been made by a revolutionary new ruling technique. The mechanical difficulties to be overcome in precisely cutting a large number of parallel grooves – about 15,000 to the inch – for an op-

*(Continued on page 66)*

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## BIW "SUPER-JET" 1000°F INSULATED WIRES

**BIW "Super-Jet" Insulation** is the brand name given to a form of insulation applied to a series of insulated wires and cables designed for temperatures of 1000°F.

This insulation is fibrous in form. At the same time it is protected to some degree from absorption of moisture from the air under humid conditions. The process of decomposition or heat aging at this temperature does not leave a carbon deposit which would deteriorate the insulation.

Two classes of use and ratings have been adopted. For Instrument Wiring voltages usually not over 120 volts A.C., and given a rating of 300 volts, a minimum thickness of insulation is used to provide a small diameter and lightweight cable for instrument circuits. For Power Cable adequate insulation is applied to provide a rating of 600 Volts A.C.

Both classes of cable are made in the shielded and unshielded types. The shielding consists of stainless steel braid which is recommended in all cases where abrasion is an important factor in the life of the cable.

*SUPER-JET INSTRUMENT WIRING*

| *Size* | *O.D.* | *Price per Foot 100′* | *250′* | *500′* | *1000′* |
|---|---|---|---|---|---|
| #24 Gauge | .100″ | $ .55 | $ .45 | $ .40 | $ .35 |
| #24 Gauge Shielded | .125″ | .60 | .50 | .45 | .40 |
| #20 Gauge | .110″ | .60 | .50 | .45 | .40 |
| #20 Gauge Shielded | .135″ | .65 | .55 | .50 | .45 |
| #16 Gauge | .135″ | .70 | .60 | .55 | .50 |
| #16 Gauge Shielded | .160″ | .80 | .70 | .65 | .60 |

*SUPER-JET POWER CABLE*

| | | | | | |
|---|---|---|---|---|---|
| #20 Gauge | .150″ | .80 | .70 | .65 | .60 |
| #20 Gauge Shielded | .175″ | .90 | .80 | .75 | .70 |
| #16 Gauge | .160″ | 1.00 | .90 | .85 | .80 |
| #16 Gauge Shielded | .185″ | 1.10 | 1.00 | .95 | .90 |
| #12 Gauge | .200″ | 1.20 | 1.10 | 1.05 | 1.00 |
| #12 Gauge Shielded | .225″ | 1.30 | 1.20 | 1.15 | 1.10 |

This important development is now available and is brought to the attention of engineers for the first time in this advertisement.
**October 1957**

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## When M.I.T. was "Boston Tech"

*By Samuel C. Prescott '94*

Here, told in terms of the men who did it, is the story of the beginning and growth of the Institute on Boylston Street to its embodiment in the great school on the Charles in Cambridge . . . xvii+350 pp. with 14 pp. of illustrations.

**Price $6.00 per copy postpaid—*or* in combination with a copy of the current *1955 Alumni Register*, $8.00.**

**Orders will be filled by the:**

**Alumni Association**
**Room 1-290, M.I.T.**
**Cambridge 39, Mass.**

## ALUMNI OFFICERS' CONFERENCE

*(Continued from page 64)*

tical grating 10 inches long are immense. But by using a combination of interferometry and feed-back servomechanisms, Dr. Harrison has been able to produce gratings 10 inches or larger with precision not previously attainable, so that resolution is considerably increased. It appears that the new technique is about to open a new era of spectrographic research.

Dr. Frank discussed the many contributions of the Laboratory for Nuclear Science and the Research Laboratory of Electronics to the educational program of the Institute. He noted, for example, that over the past 11 years (essentially the life span of L.N.S. and R.L.E.) 271 of a total of 323 doctoral men in physics have been involved in the research programs of the two laboratories. He also cited instances of increasing interplay between the research laboratories and the undergraduate curriculum. Not only are the staffs of the laboratories devoted to the education of students, Dr. Frank concluded, but they are creating a happy union of research and teaching that may set a pattern for institutions of higher learning in the rest of the nation.

At the conclusion of these discussions of some current examples of M.I.T. research, laboratory visits were scheduled to the Computation Center, the synchrotron, and the atomic clock. Sample operations on the new I.B.M. 704 computer were explained by Frank M. Verzuh, '46, Assistant Director, Computation Center. At the synchrotron the operation of this 350 million volt electron "gun" was described by Louis S. Osborne, '50, research physicist, who also discussed the relationship of this accelerator to M.I.T. research and education in high-energy physics. In a third laboratory, the principles and uses of the atomic clock, in which time-keeping is controlled with fantastic accuracy by the oscillations of electrons in the cesium atom, were explained by John G. King, '50, Assistant Professor of Physics.

### Faculty Club Luncheon

The conference closed on Saturday noon with a luncheon at the Faculty Club and a concluding inspirational address by Corporation Chairman Vannevar Bush, '16.

Dr. Bush reviewed some of the trends in engineering education which had been discussed in other parts of the program. He put special emphasis on the personal qualities engineers will need as their work becomes more professional in its functions. "Engineers of the future," said Dr. Bush, "will need especially to have wide interests, coupled with a new flexibility of mind and a broader perspective in judgment."

In delineating the characteristics of the professional man, Dr. Bush stressed his belief that central to

*(Concluded on page 68)*


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## ALUMNI OFFICERS' CONFERENCE

*(Concluded from page 66)*

every idea of professional work is the thought that the professional person ministers to his fellow man. He ministers not servilely but with dignity and pride and out of his labors comes a new civilization. The professional man, Dr. Bush added, not only speaks with authority in his own field, but is also able to work unselfishly in harness with others. While he insists on an adequate and proper return for his labors, he values the intellectual aspects of his life more highly than the financial.

Dr. Bush wove part of his remarks around an anecdote about a business man he had recently met in a barbershop. This young man, he noted, was in business for himself and making about $70 a week – a net which Dr. Bush thought was pretty good, considering that the business was a paper route and the proprietor was only 11 years of age. This youngster confided that he intended to go to M.I.T. and hoped, ultimately, to become a contractor. "Now M.I.T. wants youngsters," Dr. Bush continued, "who not only have high intellectual capacity but who are also willing and able to do good, conscientious work. These young men should be devoted to an ideal, should have courage, ambition, and resourcefulness." In closing the meeting on this theme, Dr. Bush urged all Alumni to keep their eyes open for youngsters of this kind – just as he promised to keep his eyes on the young man in the barbershop.

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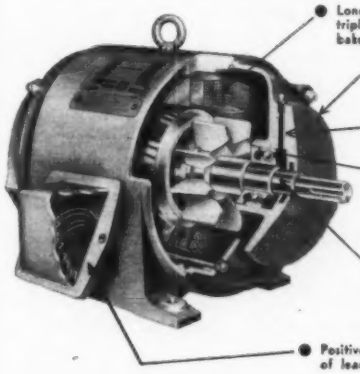
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High tensile steel, precision ground shaft and balanced rotor assembly.
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Mr. WILLIAM E. BOYER — NEW YORK LIFE AGENT

at SHREVEPORT, LOUISIANA

**BORN:** October 15, 1930.

**EDUCATION:** Tulane University, School of Business Administration.

**MILITARY:** U.S. Air Force (Intelligence Officer) August '52—July '54. Korea Service.

**PREVIOUS EMPLOYMENT:** Summer jobs during school.

**REMARKS:** Son of a former Governor of the State of Louisiana and son-in-law of a New York Life agent, William Boyer followed the latter's lead and joined New York Life in September, 1955 under a special sales trainee program. This was Mr. Boyer's first full-time job—coming immediately after his consecutive stints at Tulane University and with the U.S. Air Force. A year later he became a full-fledged agent. His intense interest in life insurance has led him to completion of 2 advanced life insurance underwriter courses since becoming a New York Life agent. And his first-year sales record of $1,121,447 is a further indication of this young man's outstanding success potential with New York Life.

*Note*

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## KARL COMPTON — SCIENTIST

*(Continued from page 28)*

Although Karl Compton was a physicist, this was to some extent a matter of chance. He started out tentatively to be a biologist, and it was only the accident of being given an assistantship in the Physics Department, when the one he had been promised in biology fell through, that led him toward the more basic science. In fact, for one year as a graduate student he was an instructor in chemistry, but then he went into physics for good. He also pulled his brother Arthur into physics, for when Arthur went to college he was going to become an engineer. However, he liked physics, and he came one day to his older brother Karl with the problem of what he should become. Karl said, "Do you want to be the kind of person who looks figures up in a handbook, or do you want to be the kind of person who puts the figures into the handbook?" Arthur became an industrial physicist as a sort of compromise, but eventually found his forte in basic research like Karl.

Karl Compton, the physicist, Director of the Experimental Laboratories of Physics at Princeton, and in 1929 the newly made head of the Physics Department there, did not really want to become the president of M.I.T., but he had a very strong sense of duty. He deliberately sacrificed his scientific career to make a much greater contribution, one which affected the progress of science and of many allied fields far more profoundly than could ever have been the case if he had remained a scientist of any kind.

So I think it appropriate today not to talk about Dr. Compton's contributions to the national scientific scene as a beloved elder statesman, but rather of those he made as a scientist who took great joy in the experimental approach to unraveling the secrets of nature.

I first met K.T. in his Princeton laboratories just about a third of a century ago. He was then 38, and had been a full professor at Princeton for some six years. He was already one of the big names in the new field of electronics, which has since blossomed to become one of America's greatest industries. He had great drive and great enthusiasm and became the founder of a school of physicists, composed of Ph.D.'s who did their thesis work under him, that is still scattered widely about the country unto the third and fourth generations. By 1930, when he

*(Continued on page 72)*


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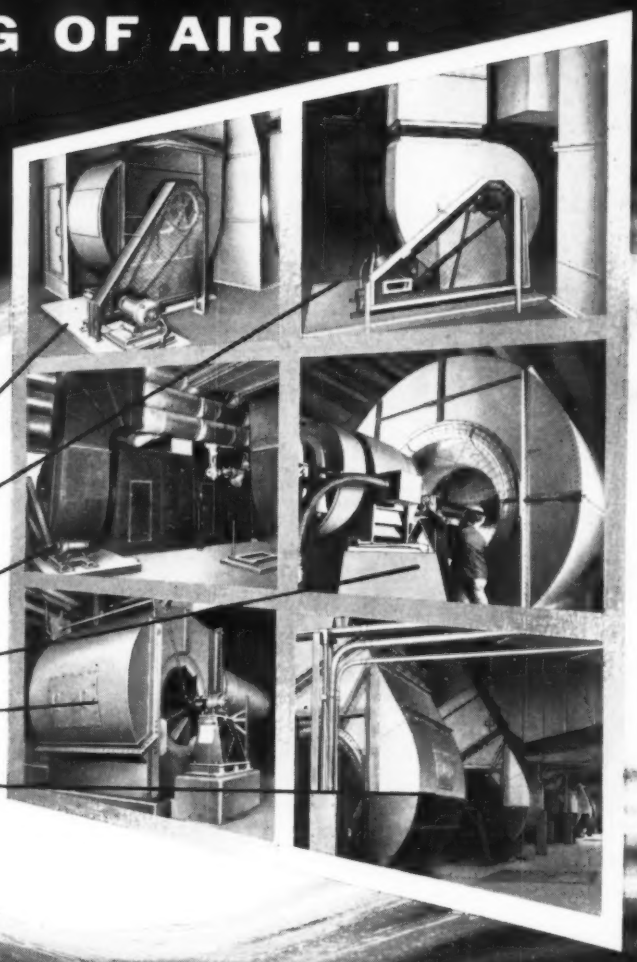

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## KARL COMPTON — SCIENTIST

*(Continued from page 70)*

came to M.I.T., K.T. had published more than 100 technical papers in fields of physics ranging from photoelectric thresholds to spectroscopy in the extreme ultraviolet.

Young Karl's first scientific article appeared in the *Physical Review* in February, 1910. Its title was "A Study of the Wehnelt Electrolytic Interrupter." His doctor's thesis had to do with the measurement of the velocities of electrons emitted when ultraviolet light falls on a metal plate. In 1913 he wrote a paper entitled "Note on the Velocity of Electrons Liberated by Photoelectric Action" which was published in the *Physical Review*. Then the papers began to come thick and fast. That he entered into the same kinds of friendly but animated controversies that modern physicists carry on is shown by two papers that I find in his list of publications. The first is "Temperature Coefficient of Contact Potential," and the second is "Temperature Coefficient of Contact Potential. A Rejoinder."

Picking the year 1924 as a random example, I find 13 scientific papers published by K.T., alone or with colleagues. Most of them had to do with low-voltage arcs, striated glow discharges, and excited atoms. In 1925, there were again 13. By the time he came to M.I.T. as president, he had published 108 papers. Ten or a dozen more scientific papers appeared in the two or three years following his induction, but

*(Continued on page 74)*

*Architects:* Skidmore, Owings & Merrill
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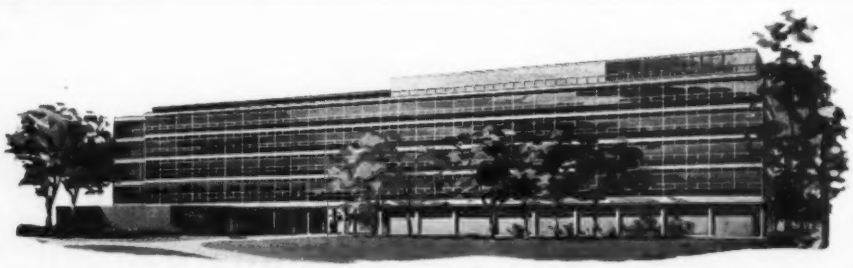

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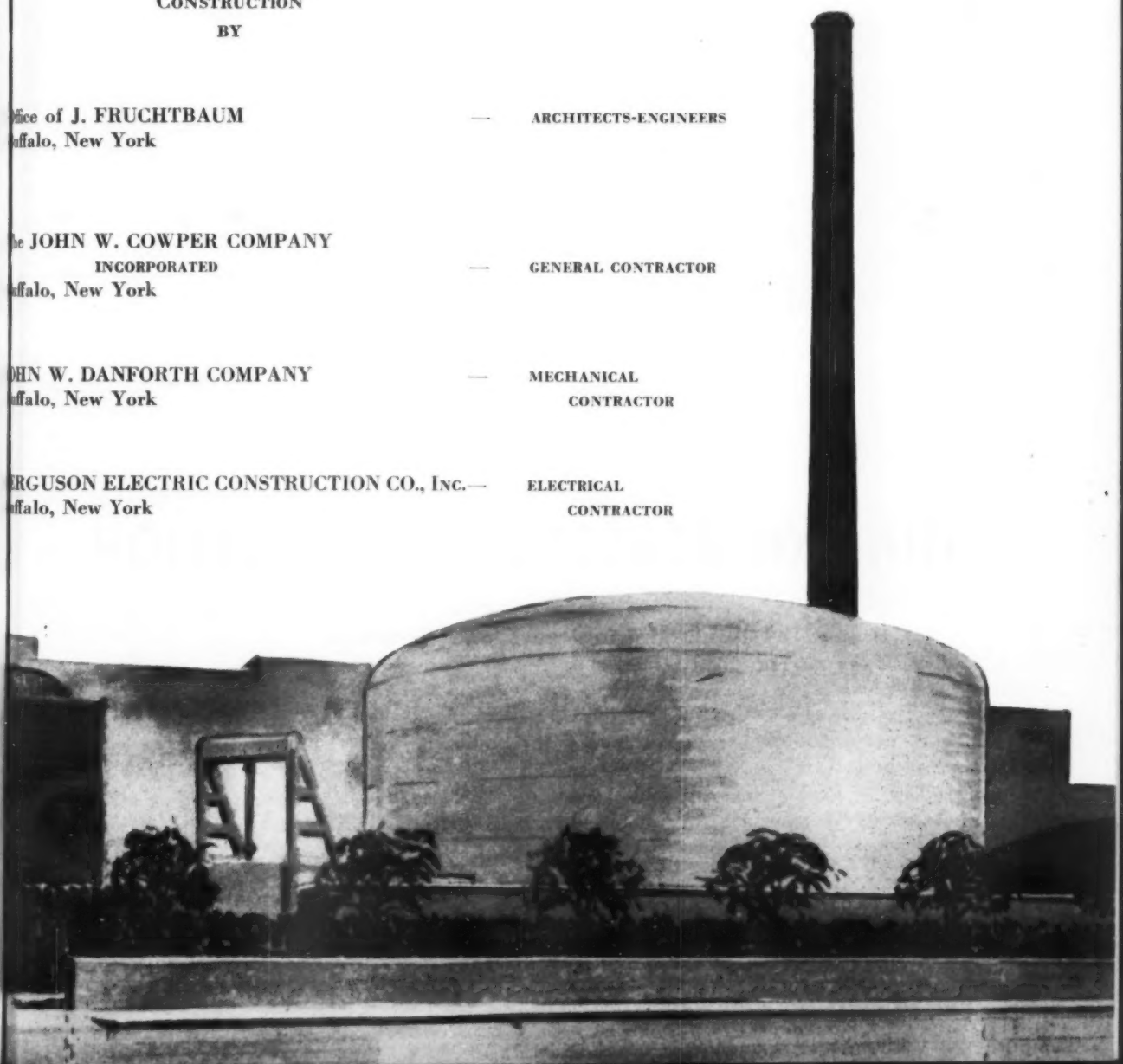

## KARL COMPTON — SCIENTIST

*(Continued from page 72)*

soon the trials of the administrator began to take their toll. His writings gradually became more general, and we find him in July of 1932 writing on the "Long-Range Budgeting of Public Capital Expenditures" and on "M.I.T.: Its Past, Present, and Future." But paper number 378, his next to the last publication, which appeared in 1953 was "Establishment of the Radiation Laboratory at M.I.T." So he held his great interest in laboratories to the end.

With his brother Arthur, Karl invented the Compton Electrometer, a very sensitive modification of the then widely used quadrant electrometer, which they first described in 1919. This instrument came into fairly wide distribution although its use was limited by the fact that the instrument company that was given responsibility for its commercial production constructed it rather poorly, and by the fact that it was soon supplanted by more convenient vacuum-tube methods for reading very small currents.

I have told elsewhere how K.T., when he first became president, was determined to continue his researches in vacuum spectroscopy in the Spectroscopy Laboratory, and agreed to work two days a week there, come committees or high water. But the pressure of his new presidential duties made it increasingly necessary for him to postpone his visits to the laboratory. Finally, when his assistant called up and wanted to know when he was going to get some direction, Dr. Compton spent a happy two hours cleaning out the insides of a mercury condensation pump with kerosene, until in the middle of the afternoon an urgent telephone call took him back to his office, and this was the last the laboratory saw of him as an active participant. This was not of his own choice, however, and during the remainder of his life he got his scientific thrills vicariously by paying visits whenever possible to experimental laboratories.

I found in my files the other day a three-page single-spaced typewritten letter written by the new president of M.I.T. from his position as professor of physics at the University of Chicago in the summer of 1930. This letter is filled with details regarding the design of the new laboratory, requests for further information, authorization to purchase pumps and vacuum spectroscopic equipment, and is exactly the type of letter physicists write to each other today, except that the voltages involved are usually now boosted and the wave lengths diminished by factors from 1,000 to 1,000,000, and the costs have been upped from 10 to a thousandfold.

After K.T. took his doctor's degree in physics in the Graduate School at Princeton in 1912, he became one of the best teachers of physics in the United States. He had a clear and powerful intellect, a strong interest in using his hands in experimentation, and a willingness to investigate a scientific field for its own sake without worrying too much about making some great discovery and achieving undying fame. I am sure that the times he enjoyed himself most, except when he was with his family, were when he was

*(Concluded on page 76)*

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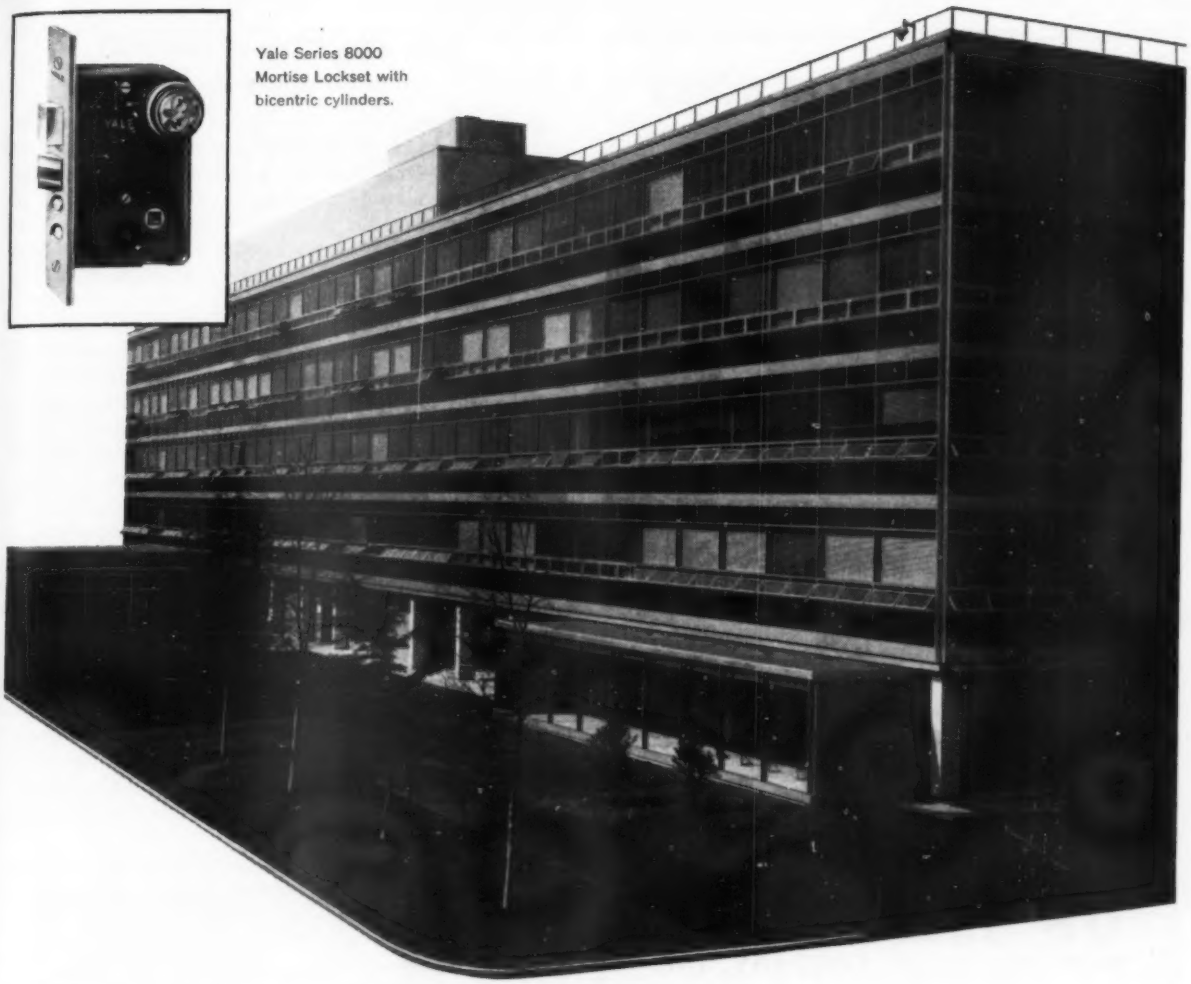

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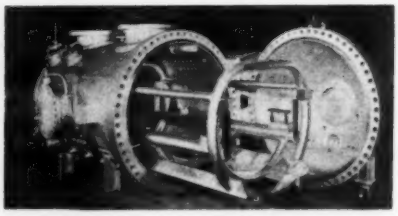

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## KARL COMPTON — SCIENTIST

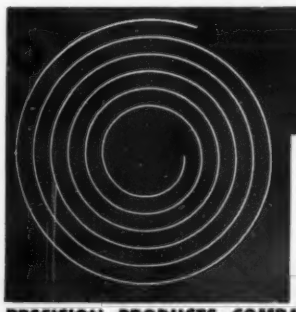
*(Concluded from page 74)*

blowing glass for a complicated vacuum setup, or plotting curves of readings obtained by applying various potentials in some electronic experiment. But his contacts with men and events were so broad, and the demands on his attention became so great, that he was never able to shut out the external world and focus his attention in the way that often earmarks the penetrating scientific genius.

I do not know what K.T. would have discovered if he had remained a scientist that has not now been discovered by someone else. But I do feel sure that the world has gained, and we all may be grateful, that he went on to do so many things that no one else could have done so effectively. He was talented as a scientist, but he was a positive genius in human relations. He thus attained renown not only as a scientist, but as an administrator, an organizer, a rallier of support to good causes, and a statesman of scientific understanding.

Today, however, let us think of him as a man who gave up the career that interested him most so that he could help make it possible for many other scientists to work in laboratories like the one we are dedicating today. He dedicated to us the great virtues that sprang from his tremendous human qualities, his great moral stature, his spiritual vigor, his transparent honesty, his freedom from guile, his sincerity, and his natural simplicity. We are thus celebrating a mutual dedication.

President Killian has expressed appreciation on behalf of the Institute to all who have contributed so much to make this great new laboratory possible. I want to express appreciation to these contributors also in behalf of all the scientists who will use the laboratory. Especially do we owe a debt to President Killian himself, and to Chancellor Stratton and his other colleagues, who went through untold hours of thought, worry, planning, re-dedication, and general financial bustling-about to make the building become a reality. Now it is here, and we are in it. The Computation Center, the Research Laboratory of Electronics, and the Laboratory for Nuclear Science are already flourishing entities with great achievements to their credit – they enter this new home with their wheels rotating at top speed, and their drivers ready to grip the new rails on contact. Karl Compton would have rejoiced to see this day, and in his name we dedicate this laboratory.

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## TREND OF AFFAIRS

*(Concluded from page 26)*

participate in the instructional program and in the thesis work of the school. Students from other maritime colleges and from other schools in the United States are admitted as far as facilities permit.

Sixteen American schools besides M.I.T. have sent students to the program, with Yale having sent the most. These U.S. students have come from 36 of the 48 states. Foreign students from every continent of the globe have also participated in the program.

The curriculum of the school covers a period of 10 weeks, part of which is devoted to practical field mapping and more detailed studies related to the natural resources of Nova Scotia. In the past 10 years, students at the school have set up and occupied more than 50 camp sites for their field work.

This international co-operative venture in geological instruction and research was initiated by Walter L. Whitehead, '13, Associate Professor of Geology at M.I.T. who retired last June; Professor Donald J. MacNeil of St. Francis Xavier University in Antigonish; and Harold D. Smith of the Nova Scotia Research Foundation. It has been sponsored and supported from the beginning by the Nova Scotia Department of Mines. Additional assistance has been given by the Nova Scotia Research Foundation, the Dominion Coal Company, and the Geological Survey of Canada.

## PRESIDENT'S ANNUAL REPORT

*(Concluded from page 42)*

The Institute now owns the Armory on Massachusetts Avenue. It will be vacated by the state when a new National Guard Armory is completed in another part of Cambridge; then, after renovation, it will become an integral part of the Institute's athletic plant.

This fall we will begin the gradual demolition extending over a two-year period of Westgate and Westgate West, temporary wooden structures which have been utilized since 1946 for the housing of married students and their dependents. This step has been necessitated by recent zoning rulings of the Cambridge Board of Appeals and by the deterioration of these temporary buildings. We are now studying plans to determine whether we can find an economic way to build permanent housing for some portion of the 1,200 married students in our student body.

### M.I.T. Community

President Killian's annual report concludes with a review of the major events that have taken place on the campus and the contributions which have been made to M.I.T. activities by visiting scholars from all parts of the world. Again, many of these events have been mentioned in the pages of The Review during the past school year and, therefore, are omitted in this condensation.

Dr. Killian's ninth annual report to members of the M.I.T. Corporation is a scholarly and significant document, well worth reading in full by all who are interested in higher education.

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## NEW SCIENCE FACILITIES

(*Continued from page 38*)

as 40 experiments simultaneously. In addition, a medical therapy room is provided in the basement for medical studies on the use of reactor radiations. The basement also includes a gamma-radiation facility (water-filled steel tank in which spent fuel elements are stored), chemistry "hot labs," the reactor control room, and an equipment room for servicing the reactor.

Inside the steel shell of the reactor building is a concrete wall two feet thick which serves as a shadow shield in the unlikely event that substantial amounts of radioactive material escape into the building.

The heart of the reactor consists of a tank, four feet in diameter, filled with "heavy water" to a depth of seven feet. Inside the tank of heavy water are the 19 fuel elements consisting of thin sheets of aluminum and Uranium-235 sheathed in aluminum tubes three inches square and two feet long. When the reactor is in operation, this fuel will produce a nuclear reaction, giving off heat, neutrons, and gamma radiation. Samples of the materials to be irradiated can be inserted through the ports into an annular graphite region surrounding the reactor. At the design power level of 1,000 kilowatts, the reactor is expected to produce a maximum flux of about $3 \times 10^{13}$ thermal neutrons per square centimeter per second, with an average of $1.8 \times 10^{13}$ thermal neutrons per square centimeter per second.

The graphite region is surrounded by a boron-containing neutron shield, by a steel and lead gamma shield three inches thick, and by a concrete shield five and a half feet thick. These shields absorb substantially all of the neutron and gamma rays leaving the center of the reactor and make it perfectly safe to work near the reactor.

Access to the reactor is through a number of openings or ports. There are six 4-inch radial ports, six 6-inch radial ports, one 12-inch radial port, one 6-inch through-port, and two 4-inch through-ports for experimental purposes, and four 4-inch instrument ports. There are also six vertical thimbles into the graphite region, from the top of the reactor, and up to 10 small sample thimbles that can be inserted in the

(*Concluded on page 82*)


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## NEW SCIENCE FACILITIES

(*Concluded from page 80*)

supplementary fuel positions at the edge of the core.

A large port beneath the reactor can be used to direct a neutron beam downward into the medical therapy room. It is hoped that a thermal neutron flux of $10^{10}$ neutrons per square centimeter per second can be achieved at the ceiling of this room. A shutter used to close the medical port consists of a tank of water beneath the reactor tank. When filled, this serves to moderate and absorb the large part of the neutrons. A boron-containing shutter and additional shielding for gamma rays are also provided. When radioactive radiation is required in the medical therapy room, the water in the tank is removed. In addition, a movable sliding shutter is pushed to one side, removing the boron from the path of the beam. Sufficient bismuth is allowed to remain in the path of the beam to reduce the intensity of gamma radiation to an acceptable level.

Twenty-six fuel elements, containing a total of five and one-half pounds of Uranium-235, will be loaned to M.I.T. by the Atomic Energy Commission who will reprocess the fuel when consumed. The uranium elements will serve as a source for the generation of neutrons, nuclear particles which will be used in research, in medical therapy, and in the training of nuclear engineers. The A.E.C. will also lend five tons of heavy water for use in the operation of the reactor.

J. Fruchtbaum, Buffalo, was the architect for the reactor building and the John W. Cowper Company, Inc., of Buffalo was general contractor. ACF Industries of Washington designed and manufactured the reactor.


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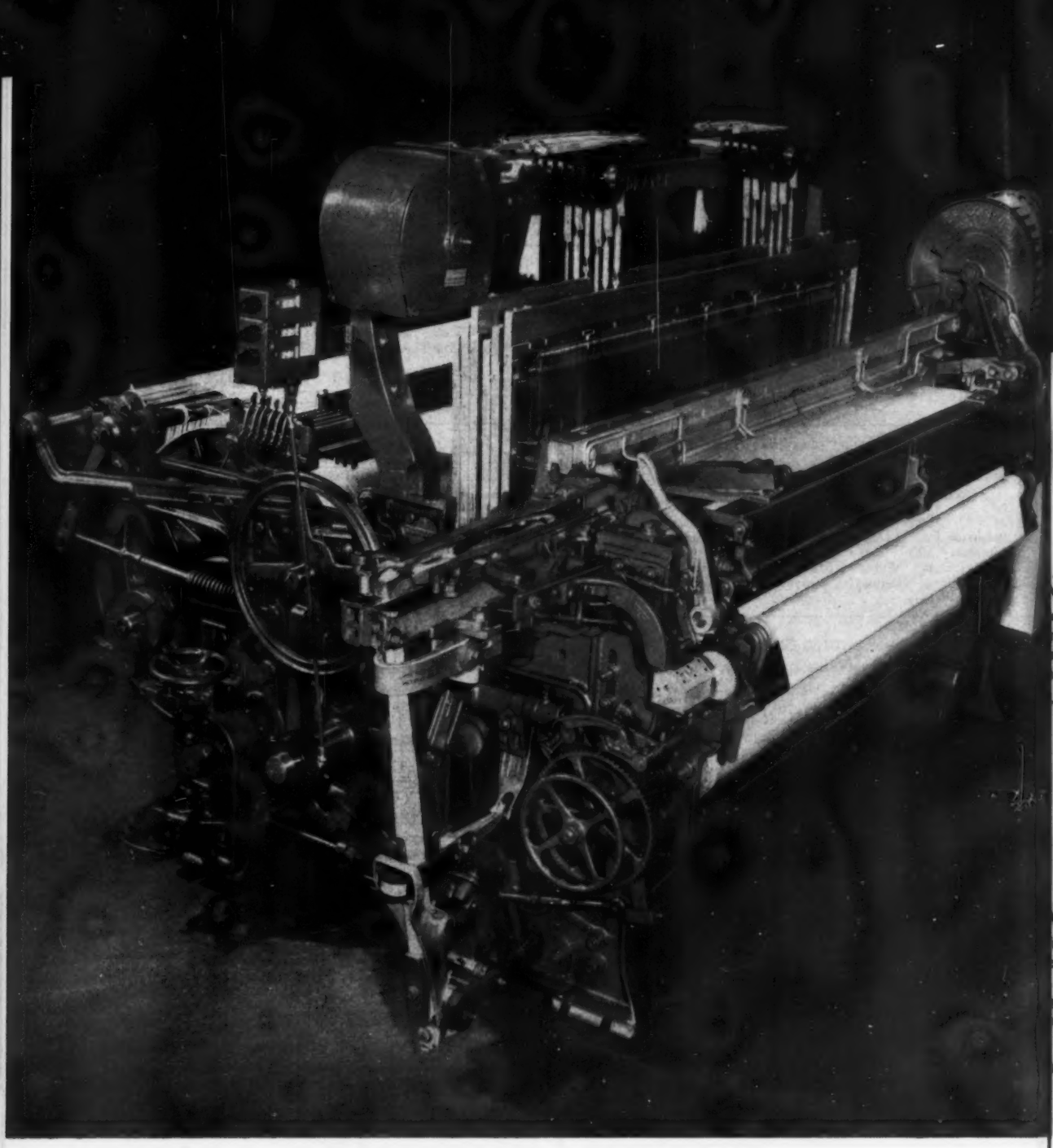

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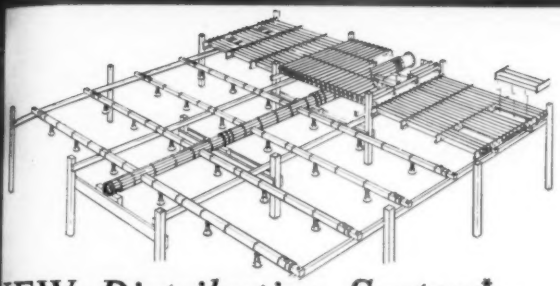
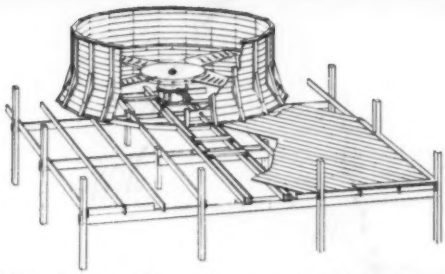
# ...e new IMPROVED Fluor "FPA" Cooling Tower

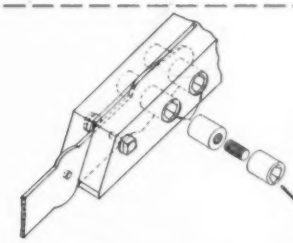
## ...your best DESIGN buy because...



**NEW *Distributing System**** Com-...tely non-corrosive... header and laterals of redwood stave con-...uction banded with stainless steel... nozzles of porcelain and ...inless steel. All headers and laterals are provided with cleanout ...lves and plugs for flushing during tower operation.

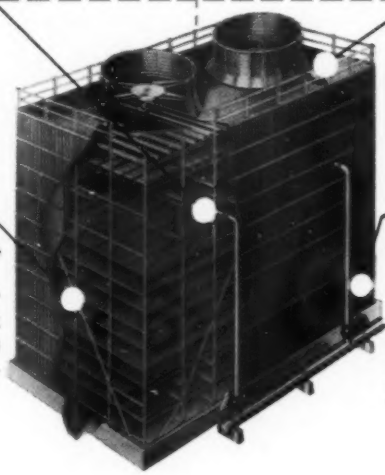


**NEW *Fan Deck and Stack*** Diagonal decking, blocking and stress strips form a *structural diaphragm* which distributes live loads—wind, vibration—uniformly to *all* bracing. New stack has stress strip around entire periphery.



**NEW *Joint Connectors**** ...ique round-headed socket nuts present a greater ...aring surface to the wood than does bolt shank ...allowable value per connector is increased. This ...gether with the heavier gusset plate design, effec-...ely multiplies each joint's allowable load.

*Patent applied for.*



**NEW *Offset Louvers*...** Set three feet out from side, yet require no greater basin dimensions. Air is drawn into tower with less pressure drop. Improvement in winter operation... icing problem formerly associated with louvers adjacent to tower columns eliminated.

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Engineer at Electric Boat Division uses G-R Vibration Meter and Vibration Analyzer to determine degree of dynamic balance of new Vaneaxial Blower. Sound-Level Meter and Octave-Band Noise Analyzer (furthest from operator) measure airborne sound level and frequency distribution of sound, respectively. G-R Strobotac (at lower right on seismic mass) conveniently measures fan speed without imposing drag or otherwise affecting operation.

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